Dräger
MEDICAL

Dräger Vapor® 2000

Anesthetic Vaporizer

Operating Instructions

MT-505-98

Dräger

NOTICE

Proprietary Information

This document contains information in which Dräger claims proprietary rights. The information may not be reproduced in whole or in part except as authorized in writing by Dräger. This information is the property of Dräger, it is provided solely for the use intended.

Repairs/Modifications

Repairs on this device shall be performed only by DrägerService or its Authorized Service Centers. Information about repairs can be obtained from Dräger or Authorized Dealers. Dräger will not be responsible for injury to persons or damage to property arising directly or indirectly out of unauthorized repairs or modifications to this device. Furthermore, any unauthorized repairs or modifications void any warranty extended by Dräger.

This document is provided for your information only. It will not be exchanged or updated without request.

Trademarks

NOTE: In order to make it very clear which Operating Instructions are to be used with each Vapor, the serial number of the Vapor 2000 assigned to these Operating Instructions is indicated on the back of this document.

Operating Instructions without such a number are issued purely for informational purposes and not for actual use with a Vapor. On each Vapor, the serial number is indicated on its nameplate.

Contents

Operator's Responsibility for Patient Safety

For correct and effective use of the product and in order to avoid hazards, it is mandatory to carefully read and to observe all portions of this manual.

The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, largely to the specifics of the Draeger design. This publication excludes references to various hazards which are obvious to a medical professional and operator of this equipment, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. Draeger disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of this product with other products whether supplied by Draeger or by other manufacturers if such a combination is not endorsed by Draeger.

The operators of the anesthesia system must recognize their responsibility for choosing appropriate safety monitoring that supplies adequate information on equipment performance and patient condition. Patient safety may be achieved through a wide variety of different means ranging from electronic surveillance of equipment performance and patient condition to simple, direct observation of clinical signs. The responsibility for the selection of the best level of patient monitoring lies solely with the equipment operator.

Limitation of Liability

Draeger's liability, whether arising out of or related to manufacture and sale of the goods, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon Draeger's Product Warranty, is subject to and limited to the exclusive terms and conditions as set forth, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to Draeger and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

THE STATED EXPRESSED WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT.

Draeger shall not be liable for, nor shall buyer be entitled to recover any special incidental, or consequential damages or for any liability incurred by buyer to any third party in any way arising out of or relating to the goods.

Warranty

All Draeger products are guaranteed to be free of defects for a period of one year from date of delivery. The following are exceptions to this warranty:

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Draeger or its representatives are not covered.
2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.
3. Oxygen sensor capsules have a six-month limited warranty from the date of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with Draeger holding the option. Draeger is not responsible for deterioration, wear, or abuse. In any case, Draeger will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. Draeger or its authorized representative must be promptly notified, in writing, upon detection of the defective material or equipment.
2. Equipment or material out of specification must be returned, shipping prepaid, to Draeger or its authorized representative.
3. Examination by Draeger or its authorized representative must confirm that the defect is covered by the terms of this warranty.
4. Notification in writing, of defective material or equipment must be received by Draeger or its authorized representative no later than two (2) weeks following expiration of this warranty.

In order to assure complete protection under this warranty, the Customer Registration Card and/or Periodic Manufacturer's Service Record (if applicable) must be returned to Draeger within ten (10) days of receipt of the equipment.

The above is the sole warranty provided by Draeger. No other warranty expressed or implied is intended. Representatives of Draeger are not authorized to modify the terms of this warranty.

Dräger Medical, Inc., Telford, PA

Definitions

Abbreviations and Symbols

Abbreviation	Meaning
Air	Medical Air
N_2O	Medical Nitrous Oxide
O_2	Medical Oxygen
CE0123	Conformité Européenne Vapor 2000 conforms to 93/42 EEC Medical Device Directive
®	Registered trademark
™	Trademark, protected trademark
% rel.	relative deviation as % of value
⚠	Refer to Operating Instructions
ON	Vapor switched on
	Operation between »**0**« setting and this mark is not allowed, as Vapor has not been calibrated for this range
0.2; 0.4;.....	Concentration scale on Vapor control dial for values up to and including 5 vol.%
6 7 8	Concentration marks on Vapor control dial that point to the danger of high dosage and limited flow range
vol.%	Volume percent anesthetic agent in fresh gas at Vapor outlet. Unit of concentration, see "Calibration", page 66
0	on key to stop control dial. »**0**« setting on control dial, see page 16
T	Transport setting (»**T**« setting) on control dial, see page 16
←	on back of Vapor or on connector indicates direction of flow of Vapor
H, E, I, S	on control dial or on plug-in adapter DW-2000 Code letter for anesthetic agent for which Vapor 2000 has been calibrated, or for which plug-in adapter is coded
min	minimum permissible filling level on viewing glass
max	maximum permissible filling level on viewing glass

Abbreviation	Meaning
ASTM	American Society for Testing and Materials
CSA	Canadian Standards Organization
EN	European Standard (European Norm)
ISO	International Organization for Standardization

Definitions of Terms

WARNING!

A WARNING statement refers to conditions with a possibility of personal injury if disregarded.

CAUTION!

A CAUTION statement designates the possibility of damage to equipment if disregarded.

NOTE: A NOTE provides additional information intended to avoid inconveniences during operation.

Inspection	=	examination of actual condition
Service	=	measures to maintain specified condition
Repair	=	measures to restore specified condition
Maintenance	=	inspection, service, and repair, where necessary
Preventive Maintenance	=	Maintenance measures at regular intervals

Typing Conventions

Control settings are designated as »Control Setting«, e.g.:

Control dial setting at »**T**«.

Summary of WARNINGS and CAUTIONS

General precautions

WARNING!

**Strictly follow this Operator's Instruction Manual.
Any use of the product requires full understanding and strict observation of all portions of these instructions.
The equipment is only to be used for the purpose specified under "Intended Use" (see page 15) and in conjunction with appropriate patient monitoring.
Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.**

WARNING!

Do not use accessories with the Vapor 2000 anesthetic vaporizer that are not listed in the ordering information (see page 73).

WARNING!

For operation in magnetic fields the combination of Vapor, anesthesia workstation, and MRI- (MRT, NMR, NMI) scanner must be tested by experts (trained and factory authorized technical service representatives for anesthetic machines and MRI scanners and application experts respectively) prior the first use to ensure proper Vapor and interface function in the specific magnetic fields. Otherwise uncontrolled concentrations and/or leakage and/or malfunction of the interlocksystem may occur (see page 34). The testing has to take into consideration all positions of the anesthesia workstation including Vapor in which it will be operated in the MRI theatre during daily use. Additionally it is necessary to check if the imaging of the MRI scanner is adversely affected by the Vapor and the anesthesia workstation.

WARNING!

Vapor can be moved by magnetic attraction. Risk of injury.

WARNING!

Under no circumstances should Vapor ever be used at atmospheric pressures and temperatures at which the anesthetic agent could start to boil (see page 67), as the concentration delivered will rise and be uncontrolled.

WARNING!

**Always handle Vapor with great care.
Be careful not to tilt or drop Vapor. Do not carry by the control dial, the protective caps or the locking lever for the plug-in adapter.
Risk of injury.
Do not use the Vapor if it has been dropped.
Damage to the Vapor may result in incorrect output concentration with the risk of serious patient injury or death.**

WARNING!

Do not use Vapor at an angle of more than 30°, when the control dial is set at »0« or above »0«, because this may result in incorrect output concentration or cause anesthetic agent to escape from the vaporizer.

WARNING!

When filled, the Vapor may be transported in any position only if the control dial is set to »T«. Any other control dial setting may cause anesthetic agent to escape from the vaporizer. Liquid anesthetic agent may effect the flow control system: The concentration delivered may be significantly higher or lower than the concentration set on the control dial.

WARNING

Vapor must always be used under the supervision of qualified medical personnel in order to obtain immediate assistance in the event of a problem.

CAUTION!

Restriction of Distribution

Federal Law and Regulations in the United States and Canada restrict this device to sale by or on the order of a physician.

Precautions during preparation

WARNING!

Use only authentic Dräger parts.
Ensure that only compatible materials are used with anesthetic agents.

Only trained and factory authorized service personnel may install connectors, because they must be dismantled and checked.

Failure to observe above precautions may result in incorrect output concentration or cause anesthetic vapor to escape from the vaporizer.

WARNING!

If the direction of flow between inlet and outlet port of the vaporizer is reversed, the delivered concentration will be incorrect and often too high.

WARNING!

If exact mounting screw specifications are not met, Vapor might come loose and fall off. Risk of injury and incorrect output concentration.

WARNING!

When using Vapor 2000 on third-party anesthesia systems, it is the responsbility of the user to ensure that all technical specifications of Vapor and anesthesia delivery system are met.
Any incompatibilities are likely to result in incorrect concentrations being delivered.

WARNING!

Take care not to spill anesthetic agent.
Do not inhale anesthetic agent vapor.
Uncontrolled inhalation of anesthetic vapors may result in a health hazard.

WARNING!

Do not use a Vapor which has been filled or partly filled with the wrong anesthetic agent or other substances. The concentration delivered may be significantly higher or lower than the concentration set on the control dial.

WARNING!

DANGER, risk of explosion if used with combustible substances.

This device is neither approved nor certified for use with combustible or explosive anesthetics (e.g. ether or cyclopropane).

WARNING!

Many anesthetic agent monitors do not identify mixtures of anesthetic agents and/or do not detect that the anesthetic agent being measured differs from the agent that was set. Unusual deviations in the concentration displayed on the monitor may indicate incorrect filling.

WARNING!

Make sure that the drainage valve is closed before filling Vapor. Significant quantities of anesthetic agent may escape if it is not, resulting in a serious health hazard.

WARNING!

If the Vapor is tilted during filling, it can be overfilled. This may result in delivered concentrations being too high or too low.

WARNING!

When filling during operation, always wait for 5 seconds after setting control dial to »0«.
This will allow for pressure to equalize in order to prevent fresh gas and anesthetic agent vapor from escaping.

WARNING!

If the connection between the filling adapter and the anesthetic agent bottle is not leak-tight, vaporizer can be overfilled and anesthetic agent vapor can escape. This may result in a health hazard.

WARNING!

Excessive force may damage seal and lever mechanism, and fresh gas and anesthetic agent vapor may escape. This may result in a health hazard.

WARNING!

A dropped anesthetic bottle may release significant quantities of anesthetic agent, resulting in a serious health hazard.

WARNING!

If filling adapter has not been connected tightly enough to the anesthetic agent bottle or to the Vapor, anesthetic agent may continue to flow into the Vapor.

WARNING!

If lever is not closed properly, fresh gas and anesthetic agent vapor may escape. This may result in a health hazard.

WARNING!

Do not store anesthetic agent bottles with their filling adapter screwed on. Anesthetic agent will escape. This may result in a health hazard.

WARNING!

If anesthetic agent bottles are not closed properly, anesthetic agent vapor will escape into the ambient atmosphere. This may result in a health hazard.

WARNING!

Always make sure to tighten sealing cap firmly. If this is not done properly, fresh gas and anesthetic agent may escape when Vapor is switched on.

WARNING!

When filling Vapor with filling spout, do not allow anesthetic agent to overflow. Do not pour between inner filling funnel and housing – anesthetic agent may overflow.

WARNING!

Take care not to injure fingers when lowering Vapor onto its adapter.

WARNING!

Never use Vapor within a breathing circuit. Risk of incorrect output concentration and high resistance.

WARNING!

The plug-in adapter must be level and stable on the o-ring seals. If this is not the case, there may be a loss of fresh gas, leaks, excessively low output concentrations, or the Interlock locking device may jam.

WARNING!

When connecting the Vapor, make sure that the direction of flow is correct and corresponds with arrow on the back of the Vapor (see page 21).

WARNING!

Always secure a free-standing Vapor against tilting and falling. Risk of injury and of damage to the vaporizer.

WARNING!

Make sure that only one Vapor is used at any one time and that only one Vapor is connected at any one time in order to prevent delivery of mixtures of anesthetic agents or concentrations which are too high.

WARNING!

If the measured value is not within the permissible range, do not use Vapor.
Risk of patient injury.

WARNING!

If it is recognized that forces or torques from the magnetic field try to turn or pull the Vapor with respect to it's normal vertical position leckage may occur.
Do not use Vapor. Risk of patient injury.

WARNING!

If it is recognized that forces or torques from the magnetic field try to turn or pull the Vapor with respect to it's normal vertical position malfunktion of the interlock system may occur.
Do not use Vapor. Risk of patient injury.

WARNING!

For operation in magnetic fields it is not permitted to connect the Vapor via hose connector or tapered connectors with the anesthesia workstation,

WARNING!

Do not use ferromagnetic keyed filler or drain adapter or tools when the filling or draining procedure is carried out in magnetic fields. Ferromagnetic adapter or tools can be moved by magnetic attraction. Risk of injury.

WARNING!

If Vapors are connected in series without an Interlock system, there is a risk that several Vapors will be switched on and operational at the same time. If this happens, gas containing anesthetic agent from one Vapor would flow into the vaporizing chamber of another Vapor resulting in uncontrolled mixtures.

CAUTION!

Only use keyed filler adapters which meet the following interface requirements regarding Vapor keyed filling system:
Square section with

- flat and even sealing surface
- flat and even chamfer on front end of sealing surface
- no sharp edges between chamfer and sealing surface

Otherwise adapters may destroy seal of keyed filling system and/or leakage will occur. High forces trying to close the interface tightly may result in damage of the lever mechanism.

Precautions during checks of readiness for operation

WARNING!

Vapor 19.n plug-in adapters, which are silver in color, must never be used on the Vapor 2000.

WARNING!

Vapor 19.n plug-in adapters, which are grey in color, must never be used on the Vapor 2000.

WARNING!

If the corrected measured value is not within the permissible range, do not use Vapor.
Risk of patient injury.
Have Vapor checked by trained and factory authorized service personnel.

Precautions During Operation

WARNING!

High temperatures at low atmospheric pressures (high altitudes) may result in an uncontrolled excessive dosage (see page 66).

WARNING!

An unsecured Vapor tilted at an angle of more than 10° may tip over.
If a Vapor is operated at an angle of more than 30°, uncontrolled concentrations may occur. (see "Transport, procedure after tilting", page 58).

WARNING!

Dräger recommends monitoring concentration using a continuously measuring monitor with an alarm system to detect deviations from set concentration, leaks, or incorrect filling, particularly for Vapors with funnel filling system. For this reason, monitors should be used which can differentiate between different anesthetic agents. The capability of the monitor should be verified prior to its use.

WARNING!

When using Low Flow and Minimum Flow, the concentration in the breathing system may deviate significantly from Vapor setting. For this reason, measurement of inspiratory and/or expiratory anesthetic agent concentration is essential.

WARNING!

Dräger recommends use of a continuously measuring oxygen monitor with alarm system for detecting insufficient supply of oxygen, e.g. due to leaks.

WARNING!

If unoccupied connectors are open, fresh gas and anesthetic agent vapor will escape and interrupt supply to the patient.

WARNING!

A malfunctioning Interlock may endanger the patient by causing overdosing or a mixture of anesthetic agents.

WARNING!

If no pre-use concentration checks are performed, an incorrect concentration may be displayed.

WARNING!

Do not set control dial between »0« and »ON« (i.e. below 0.2 vol.%).
In this range, concentration is not defined.

WARNING!

Removal of Vapors with permanent connections in magnetic fields is not permitted. Ferromagnetic screws and tools and Vapors itself can be moved by magnetic attraction. Risk of injury.

WARNING!

Abrupt movements of the Vapor or tilting the Vapor more than 30° can cause incorrect output concentration.

WARNING!

Never switch off fresh gas flow before the Vapor is switched off. A Vapor must never be left switched on without a fresh gas flow, because high-concentration anesthetic vapor may leak into machine lines and ambient air, causing damage to materials and health risks.

WARNING!

Take care not to drop Vapor. Do not use Vapor if it has been dropped. Damage may cause incorrect output concentration.
Do not carry Vapor by the control dial, control dial cap, or locking lever on plug-in adapter.
Risk of injury.
Disconnect Vapor only when control dial is set at »T«.

Disconnecting the Vapor at any other control dial setting may result in incorrect output concentration and/or cause anesthetic agent vapor to escape.

Place Vapor only on firm even surfaces or hang from stable brackets to prevent damage to Vapor or injuries.

In magnetic fields Vapor can be moved by magnetic attraction. Risk of injury.

WARNING!

For plug-in connectors without valves, the fresh-gas supply is disconnected when the Vapor has been lifted off the plug-in connector. Fresh gas and anesthetic agent vapor may escape in this situation.

WARNING!

When operating an anesthesia delivery system with more than two vaporizers and Interlock S, Interlock S may not function properly when one vaporizer is disconnected.

WARNING!

When using tapered connectors, disconnecting the vaporizer will disconnect the fresh gas line. Fresh gas and anesthetic agent vapor may escape.

WARNING!

When Vapor is tilted at an angle of more than 30°

- **anesthetic agent may overflow when control dial is set at »0«. Risk of health hazard.**
- **when control dial is set above »0«, anesthetic agent may leak and get into the flow control system causing excessively high or low concentrations when Vapor is used the next time.**

Precautions during care

WARNING!

Allowing liquids other than specified anesthetic agents to get into the Vapor may cause device malfunction and patient injury.

WARNING!

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

CAUTION!

Do not immerse Vapor or filling adapter in detergents.

Do not allow detergent to penetrate under the control dial.

Do not allow detergents to enter the gas inlet or outlet, or the filling system.

Do not sterilize Vapor or filling adapter. Damage inside may cause incorrect output concentration.

Do not use solvents on Vapor.

CAUTION!

Many materials are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately apparent.

Precautions during shut-down

WARNING!

Take care not to spill anesthetic agent. Do not inhale anesthetic agent vapor. Possible health risk.

WARNING!

Anesthetic agent which has been drained off must be handled, stored and disposed of as a drug according to institutional policy and in accordance with all federal, state, and local regulations. Failure to do so will pose a risk of administering incorrect anesthetic agents or mixtures.

WARNING!

To prevent dangerous mixtures of anesthetic agents, always verify that the anesthetic agent name and the color coding on the Vapor correspond to those on the anesthetic agent bottle.

WARNING!

Do not fill anesthetic agent bottles to the very top. This can lead to a significant amount of anesthetic agent escaping.

WARNING!

If the lever is not closed properly, fresh gas and anesthetic agent vapor may escape. This may result in a health hazard.

WARNING!

If anesthetic agent bottles are not closed properly, anesthetic agent vapor will escape into the ambient atmosphere. This may result in a health hazard.

WARNING!

The Quik Fil drainage adapter must be flush and secure on the bottle. Otherwise significant quantities of anesthetic gas may escape.

WARNING!

If anesthetic agent bottle is not screwed on tightly, the valve in the bottle will not open and anesthetic agent may leak during draining. This may result in a health hazard.

WARNING!

If sealing cap is not screwed on tightly, fresh gas and anesthetic agent may escape.

Precautions during storage and shipping

WARNING!

Always observe permissible storage temperature range (see page 61). If the storage temperature range is exceeded, internal damage to the Vapor may occur which could cause incorrect output concentration.

WARNING!

Liquid anesthetic agents and filled Vapors are subject to Hazardous Goods Regulations (under no. UN 8027 in accordance with Class 9 of IATA/ICAO). These regulations do not apply to the residues of anesthetic agents left in the wick after draining.

Precautions during maintenance

WARNING!

To avoid any risk of infection, clean and disinfect Vapor before any maintenance according to established hospital procedures – this applies also when returning Vapors for repair.

WARNING!

Preventive Maintenance work on Vapor 2000 anesthetic vaporizers shall be performed by trained and factory authorized staff only.

CAUTION!

In case of malfunction of this device, contact your local DrägerService or our Factory Authorized Technical Service Center.

The device must be inspected and serviced (preventive maintenance) by trained and factory authorized technical service representatives at regular 6 month intervals.
A record must be kept on this preventive maintenance.

Maintenance or repair of the Vapor 2000 anesthetic vaporizer shall be performed only by Dräger authorized technical service representatives.

Intended Use

The Dräger Vapor®[1)]2000 (Vapor 2000) is a non-heated, calibrated vaporizer designed to enrich the fresh gas flow of an anesthesia delivery system with a controlled amount of anesthetic vapor.

Different models of this single-agent vaporizer are intended for use with one of the following agents:
Isoflurane, Halothane, Enflurane, or Sevoflurane. Vapor 2000 is not intended for use with Desflurane, or for use within a breathing circuit.

CAUTION!

Restriction of Distribution

Federal Law and Regulations in the United States and Canada restrict this device to sale by or on the order of a physician.

WARNING!

Vapor must always be used under the supervision of qualified medical personnel in order to obtain immediate assistance in the event of a problem.

The Vapor is inserted in the fresh gas line of the anesthesia delivery system which typically delivers a continuous fresh gas flow. The Vapor is connected between the fresh gas flow-control unit and the fresh gas outlet.
The Vapor is not suitable for use in a breathing system due to high pneumatic resistance.

The concentration delivered is, for the most part, not influenced by operating and ambient conditions, such as temperature, gas flow and ventilation pressure.

Proper functioning of the Vapor is dependent on the direction of flow. The vaporizer must be connected and operated in accordance with the direction of flow specified on the machine.
The use of the Vapor with different anesthesia delivery systems is, therefore, only permissible and safe when it is used with the appropriate special adapters.
Simultaneous operation of several Vapors switched on in series is not permissible, particularly for different anesthetic agents.

Due to the pneumatic principle and the low amount of ferromagnetic material, Vapor 2000 can generally be used in magnetic fields, i. e. in conjunction with nuclear spin tomography (MRI) together with anesthetic workstations suitable for MRI.

WARNING!

For operation in magnetic fields the combination of Vapor, anesthesia workstation, and MRI- (MRT, NMR, NMI) scanner must be tested by experts (trained and factory authorized technical service representatives for anesthetic machines and MRI scanners and application experts respectively) prior the first use to ensure proper Vapor and interface function in the specific magnetic fields. Otherwise uncontrolled concentrations and/or leakage and/or malfunction of the interlocksystem may occur (see page 34). The testing has to take into consideration all positions of the anesthesia workstation including Vapor in which it will be operated in the MRI theatre during daily use. Additionally it is necessary to check if the imaging of the MRI scanner is adversely affected by the Vapor and the anesthesia workstation.

Dräger recommends that the output concentration is monitored to detect any hazardous output values, using a monitor providing continuous measurement as well as upper and lower alarm limits.

Installation and/or operation with anesthesia delivery systems in mobile vehicles, airplanes, helicopters and ships is only permissible after consultation and written agreement with Dräger Medical AG & Co. KGaA or Draeger Medical, Inc.

WARNING!

Under no circumstances should Vapor ever be used at atmospheric pressures and temperatures at which the anesthetic agent could start to boil (see page 67), as the concentration delivered will rise and be uncontrolled.

1) Dräger Vapor® is a registered trademark of Dräger

Method of Operation

WARNING!

Always handle Vapor with great care.
Be careful not to tilt or drop Vapor. Do not carry by the control dial, the protective caps or the locking lever for the plug-in adapter.
Risk of injury.
Do not use the Vapor if it has been dropped.
Damage to the Vapor may result in incorrect output concentration with the risk of serious patient injury or death.

Control dial Settings

The control dial is used to switch Vapor on and off, and to set the anesthetic agent concentration. The control dial is locked when in the zero (»**0**«) or transport (»**T**«) positions and can only be adjusted by pressing the »**0**« button.

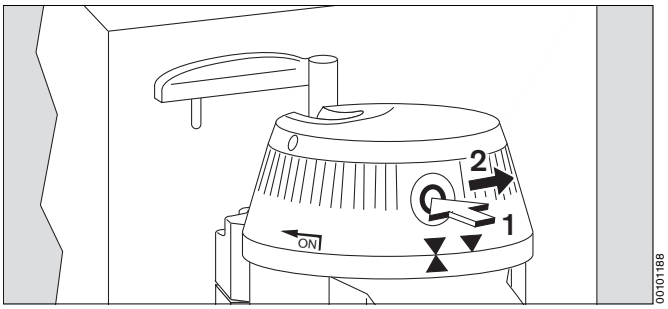
NOTE: In this manual, all illustrations of the Vapor on an anesthesia delivery system show a stylized anesthesia delivery system in the background. All illustrations of the transport setting show only the disconnected Vapor by itself.

»ON« – Switching on and adjusting concentration:

Adjust concentration only when Vapor is connected to an anesthesia delivery system.

1 **Press »0«** button and
2 turn control dial counterclockwise to the desired anesthetic agent concentration.

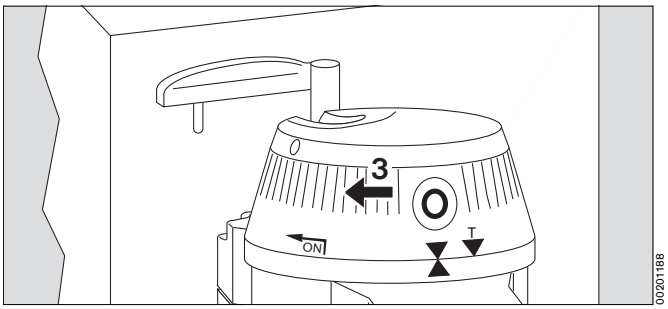
NOTE: Concentrations of more than 5 vol.% are shown in inverted form to draw attention to the risks associated with higher output concentrations and a limited flow range.



»0« – Switching off:

When the Vapor is connected to an anesthesia delivery system and no anesthetic agent is intended to be delivered.

3 Turn control dial clockwise to **»0« – »0«** button engages.

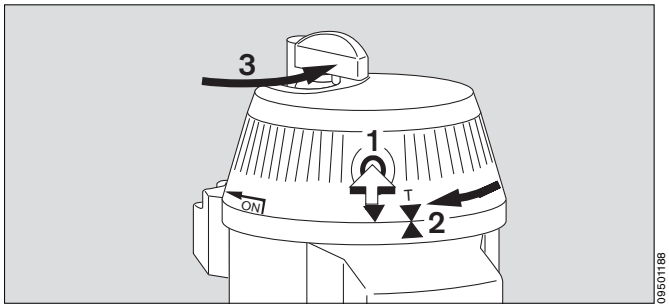


WARNING!

Do not use Vapor at an angle of more than 30°, when the control dial is set at »0« or above »0«, because this may result in incorrect output concentration or cause anesthetic agent to escape from the vaporizer.

»T« – Transport:

This position must be set each time the Vapor is removed from the anesthesia delivery system or is placed on the parking holder.



1 **Press** the **»0«**-button and
2 Turn control dial clockwise to **»T«** transport setting – **»0«** button engages.
3 For plug-in adapter, engage locking lever in the control dial.

WARNING!

When filled, the Vapor may be transported in any position only if the control dial is set to »T«. Any other control dial setting may cause anesthetic agent to escape from the vaporizer.

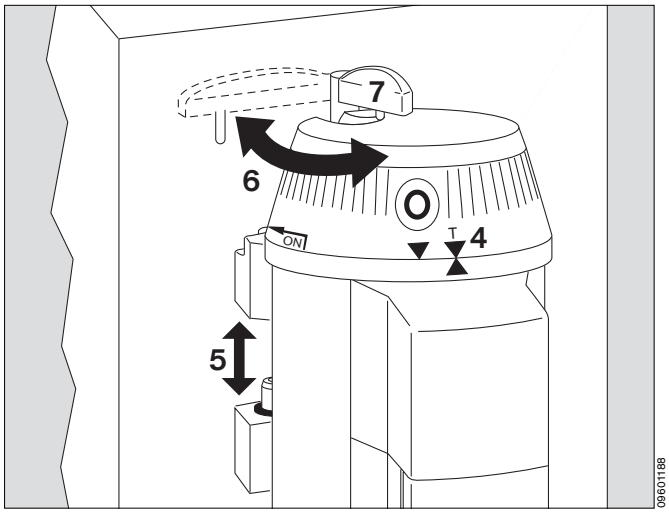
Connection and Interlock Systems

When the Vapor is used with different anesthesia delivery systems, different connection systems must be used. When anesthesia delivery systems have several Vapor connectors, the different Interlock systems[1)] ensure that only one Vapor can be used at any one time, while the others are switched off and blocked.

Plug-in adapter/Plug-in connector

This system provides for safe connection and quick change of the Vapor unit.
Most plug-in connectors have valves that allow fresh gas to flow through, whether the Vapor is connected or not. These plug-in connectors can be identified by the moveable valve inserts in the inner holes on the connector pins.

Many Vapors with plug-in adapters carry an anesthetic agent code on the back, which can be read and displayed by anesthesia delivery systems designed to take advantage of this identification system.

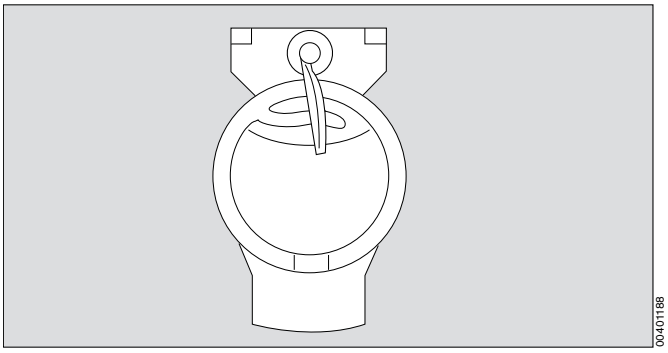


4 To connect/disconnect, the control dial must be at the **»T«** setting and the locking lever must be engaged in the control dial.
5 The holes in the Vapor plug-in adapter install onto the pins on the plug-in connector on the anesthesia delivery system.
6 To secure/release, swing locking lever into position and engage/disengage the pin in the control dial cap on Vapor.
7 The locking lever and pin help to ensure that the Vapor is handled correctly and that it can only be connected and disconnected when at the **»T«** setting.

1) The different Interlock systems are not compatible with each other. However, the Vapor can be modified from one system to another.

Plug-in adapter DW-2000 with Interlock 2

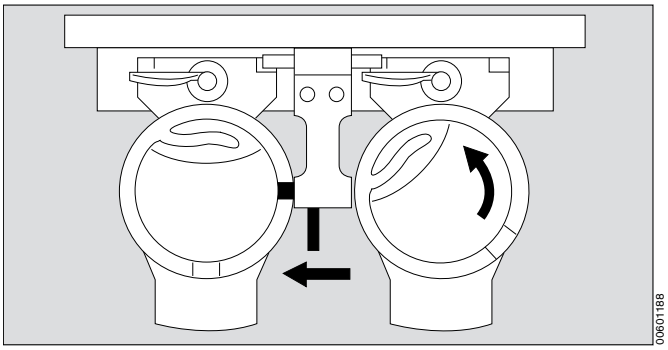
for connecting to Dräger plug-in connectors.



For anesthesia delivery systems with two plug-in connectors combined with **Interlock 2**.

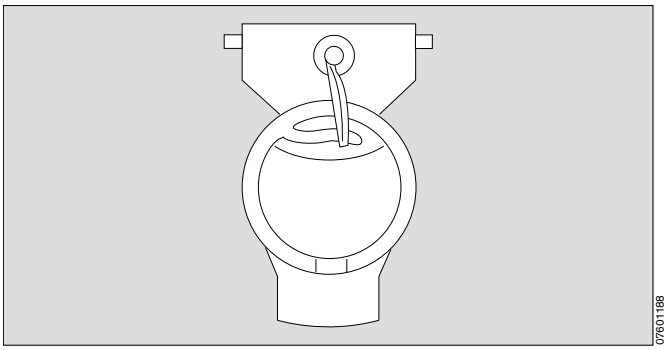
The locking bar, which can only be engaged in the control dial when at **»0«** setting, allows only one Vapor to be in use at any one time.

Illustration: left Vapor blocked,
right Vapor operational.



Plug-in adapter S-2000 with Interlock S

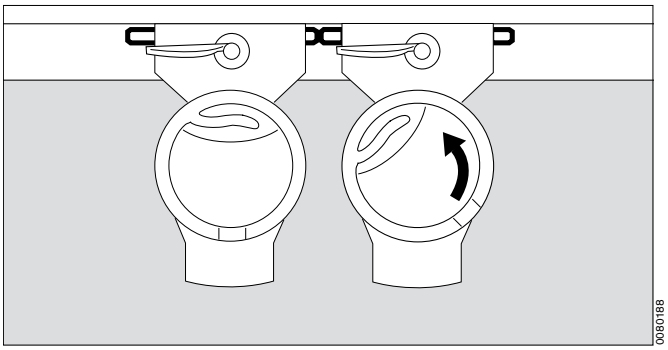
for connecting to Selectatec®[1]-compatible plug-in connectors.



For anesthesia delivery systems with several plug-in connectors combined with **Interlock S**.

When a vaporizer is switched on, two pins on the side of the corresponding plug-in adapter are pushed out. These prevent other vaporizers on adjacent plug-in connectors from being switched on.

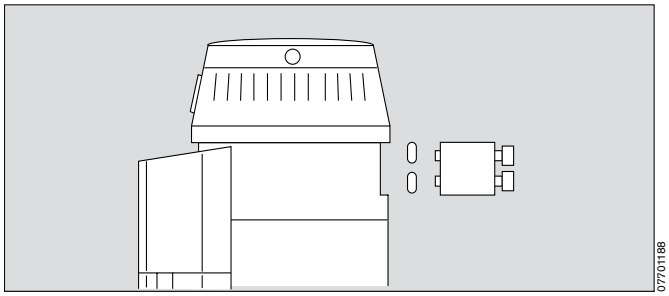
Illustration: left vaporizer blocked,
right Vapor operational.



1) Selectatec® is a registered trademark of Ohmeda.

Permanent connection with triple vaporizer exclusion systems

A permanent installation in fresh gas line for anesthesia delivery systems, with the appropriate connector options.

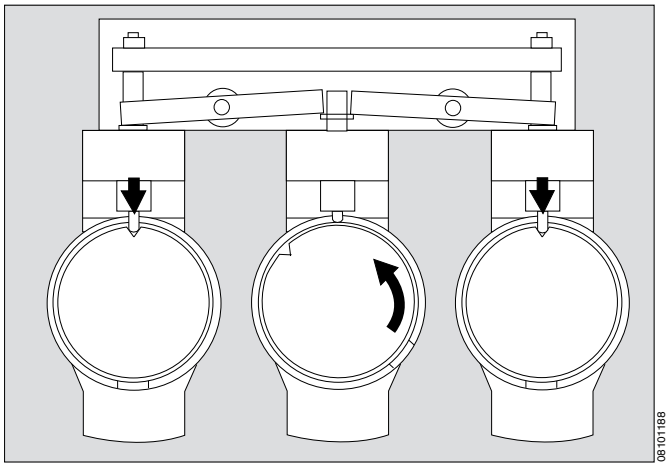


For anesthesia delivery systems with the former triple vaporizer exclusion system combined with the **Interlock NMD**.

When a Vapor is switched on, a lever is activated which prevents other Vapors on adjacent connectors from being switched on.

Illustration: center Vapor operational,

right and left Vapors blocked



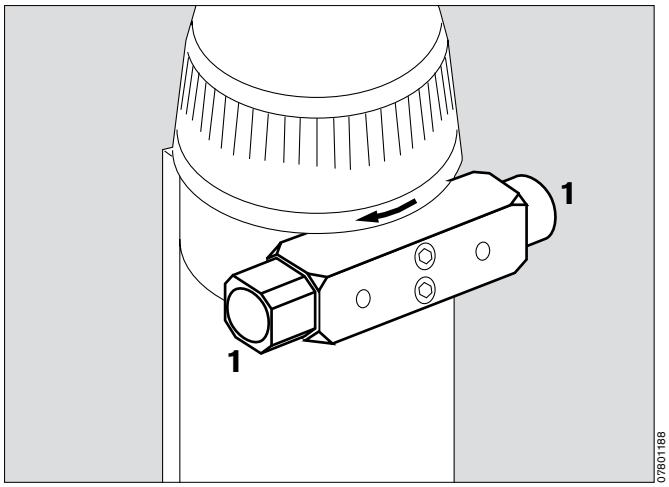
Other Interlock systems, such as Interlock 1, are also in use and very similar to the Interlock NMD. Vapors with Interlock NMD may not, however, install onto these Interlock systems.

More recent versions of Narkomed anesthesia delivery systems are also available with Interlock 2 for Vapors with plug-in adapter DW-2000.

Tapered connector, 23 mm

23 mm tapered connectors conforming to ISO 5356-1 for anesthesia delivery systems with Vapors permanently mounted on rails, socalled "Cagemount". These systems do not provid an interlock function.

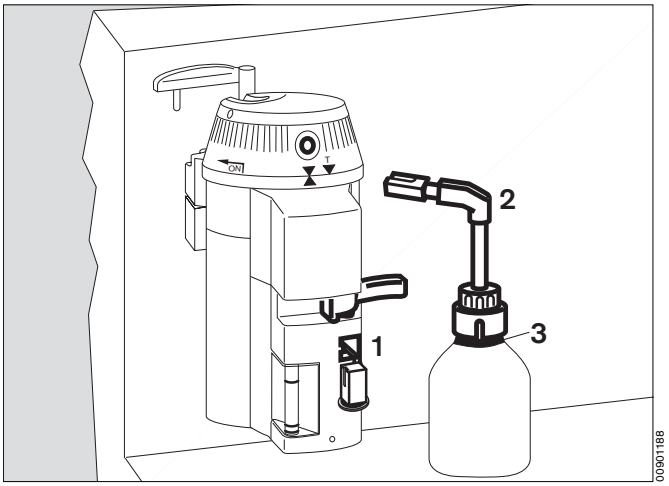
1 tapered connector on Vapor



Filling Systems

For filling the Vapor with the specified anesthetic agent and for draining.
The filling level is visible with minimum and maximum levels marked and a third (middle) mark which shows when a whole bottle (250 mL) can be used.

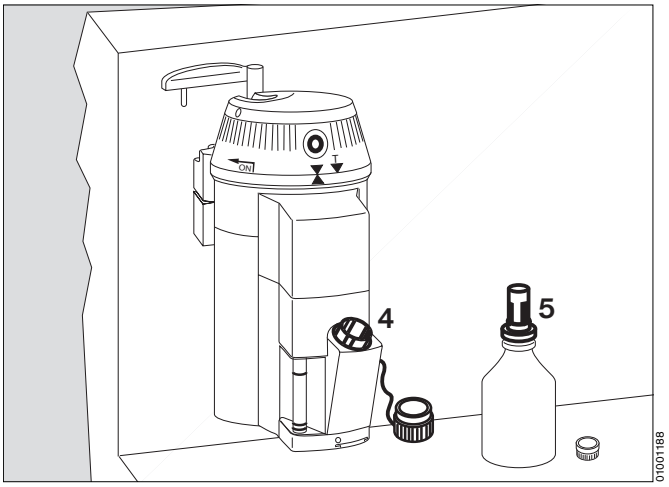
Dräger recommends the use of anesthetic agent-specific filling systems to prevent incorrect filling and to reduce the volume of anesthetic agent vapor released during the filling process.



Keyed filling system

consisting of

1 the anesthetic agent-specific filling system on Vapor
2 an anesthetic agent-specific keyed filler adapter
3 the anesthetic agent specific collar and threads on the neck of the bottle.



Quik Fil®[1] filling system

consisting of

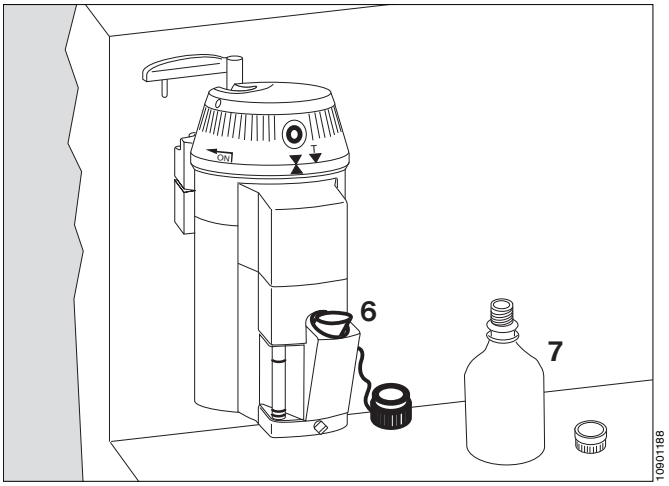
4 the anesthetic agent-specific filling system on the Vapor
5 the anesthetic agent-specific adapter on the bottle.

Vapor with funnel filling system

consisting of

6 a **non-specific** filling system on the Vapor
7 the anesthetic agent bottle.

The funnel filling system does not mechanically limit the type of agent poured into the vaporizer.
The color code and the name of the agent on the vaporizer specify the agent to be filled into the vaporizer.
If an incorrect agent is delivered by the vaporizer, some agent monitors may not correctly identify the agent, and may also display an incorrect percentage of agent vapor.
Dräger recommends using a continously measuring agent monitor with an alarm system capable of distinguishing between anesthetic agents. The capability of the monitor should be verified prior to its use.



1) Quik Fil® is a registered trademark of Abbott Laboratories

Preparation

Installation of Connection Systems

WARNING!

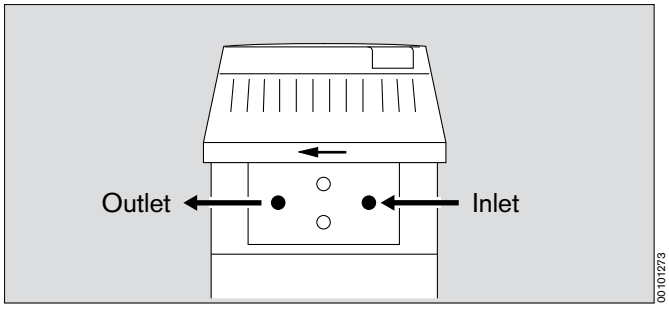
Use only authentic Dräger parts.

Ensure that only compatible materials are used with anesthetic agents.

Only trained and factory authorized service personnel may install plug-in adapters, because hey must be dismantled and checked.

Failure to observe above precautions may result in incorrect output concentration or cause anesthetic vapor to escape from the vaporizer.

- Remove protecting cap from the gas inlet/gas outlet at the back of the Vapor (if applicable).
- Always connect Vapor in such a way that the gas flow matches the illustration to the right and the arrow on the back of the Vapor.

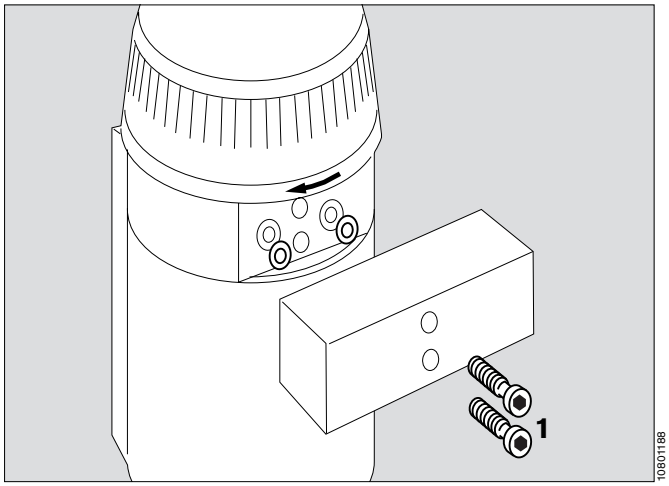


WARNING!

If the direction of flow between inlet and outlet port of the vaporizer is reversed, the delivered concentration will be incorrect and often too high.

- Follow Operating Instructions for the anesthesia delivery system.
- For tapered connectors:
  the male taper on the connecting piece is the Vapor inlet; the female cone on the connecting piece is the Vapor outlet.

1 Use two new screws – do not re-use old screws:
   — strength class 10.9, surface A2R conforming to DIN ISO 4042, heat treated.
   — dimensions DIN EN ISO 4762 (DIN 912)-M4 x length depending on connector.
   Screws fitted through the connector must be screwed into place with a thread length of not less than 5 mm and not more than 7 mm.
   If screws less than 25 mm long are used, additional centering pins must be fitted.



- Do not use any type of washers.

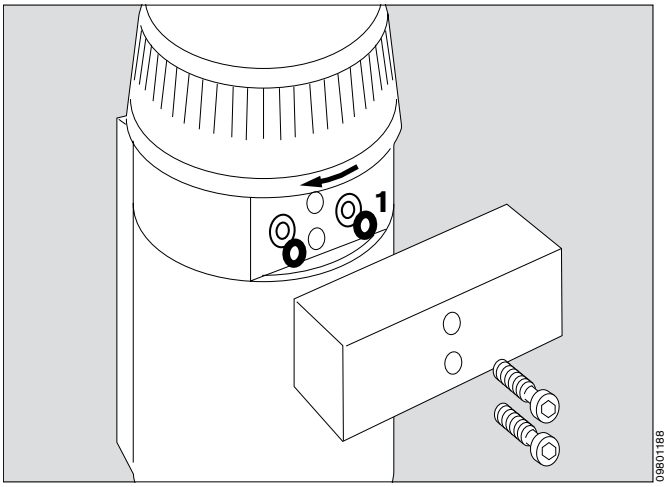
WARNING!

If exact mounting screw specifications are not met, Vapor might come loose and fall off. Risk of injury and incorrect output concentration.

- Before installation, check that the connecting surfaces, particularly the sealing areas, are clean and undamaged.

1 Place 2 o-ring seals, item no. M 21929, on the sealing areas around the gas passages.

- Tighten screws to 23 to 26 in lbs. (270 to 300 Ncm) once, do not tighten once more.
- Check that the connector is secure.



Before Using For the First Time

- Check that Vapor is undamaged.
- Set control dial to »**T**«.
- Remove locking device from gas inlet/gas outlet on the back of the Vapor, if applicable.
- Check readiness for operation (see page 35).
- Fill Vapor (see page 23).
  After filling for the first time, wait 15 minutes for the dry wicks inside to become saturated.
  The filling level of the anesthetic agent may drop; top off if required, taking care not to overfill.
- Check the concentration (see page 37).
- Use on anesthesia delivery systems made by other manufacturers only after a functional system check for geometry, pressure and flow has been carried out by trained and factory authorized service personnel (for each type of anesthesia delivery system).

WARNING!

When using Vapor 2000 on third-party anesthesia systems, it is the responsbility of the user to ensure that all technical specifications of Vapor and anesthesia delivery system are met.

Any incompatibilities are likely to result in incorrect concentrations being delivered.

Filling the Vapor

WARNING!

Take care not to spill anesthetic agent.
Do not inhale anesthetic agent vapor.
Uncontrolled inhalation of anesthetic vapors may result in a health hazard.

Recommendation: Ensure adequate ventilation when filling the Vapor when not connected to an anesthesia delivery system.
Fill the Vapor only with the anesthetic agent specified on the device.[1)]
Observe expiration date for anesthetic agent.
When using brand-name products from different manufacturers, make sure that the correct agent is used, for instance, by following the color coding of Vapor and anesthetic agent bottle:

Halothane	red
Enflurane	orange
Isoflurane	purple
Sevoflurane	yellow

NOTE: The same anesthetic agents may be sold under different trade names by different manufacturers. Approved agents may be administered separately or in combination from one Vapor and monitored with Dräger anesthetic agent monitors as long as they are identical in composition and physical and chemical properties.

WARNING!

Do not use a Vapor which has been filled or partly filled with the wrong anesthetic agent or other substances. The concentration delivered may be significantly higher or lower than the concentration set on the control dial.

WARNING!

DANGER, risk of explosion if used with combustible substances.
This device is neither approved nor certified for use with combustible or explosive anesthetics (e.g. ether or cyclopropane).

WARNING!

Many anesthetic agent monitors do not identify mixtures of anesthetic agents and/or do not detect that the anesthetic agent being measured differs from the agent that was set. Unusual deviations in the concentration displayed on a monitor may indicate incorrect filling.

WARNING!

Do not use ferromagnetic keyed filler or drain adapter or tools when the filling or draining procedure is carried out in magnetic fields. Ferromagnetic adapter or tools can be moved by magnetic attraction. Risk of injury.

NOTE: Dräger metal keyed filler adapter which are labeled with "MRI" are not ferromagnetic.

1) Only use anesthetic agents approved in the country of use

If a Vapor is filled with the wrong anesthetic agent, clearly mark Vapor with label indicating the substance and a WARNING not to use the device, then call DrägerService for repair.

WARNING!

Make sure that the drainage valve is closed before filling Vapor. Significant quantities of anesthetic agent may escape if it is not, resulting in a serious health hazard.

Always stand or hang Vapor upright while it is being filled.

WARNING!

If the Vapor is tilted during filling, it can be overfilled. This may result in delivered concentrations being too high or too low.

Vapor with keyed filling system

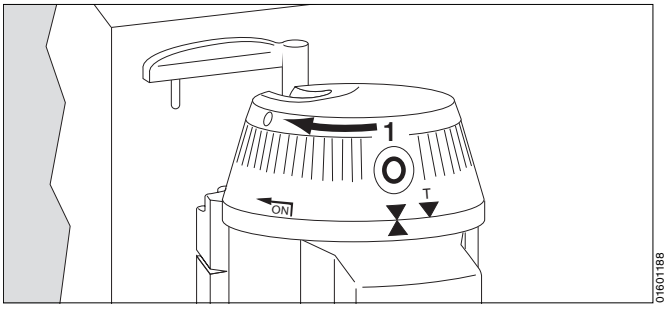
Heed all warnings on pages 22, 23.

If the Vapor is connected to an anesthesia delivery system, leave control dial engaged at »**0**« .

When filling during operation:

- fresh gas flow can remain as set.

1 Set control dial to »**0**«

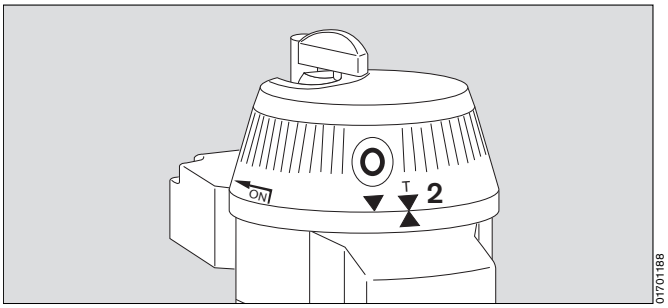


WARNING!

When filling during operation, always wait for 5 seconds after setting control dial to »0«. This will allow for pressure to equalize in order to prevent fresh gas and anesthetic agent vapor from escaping.

If the Vapor is not connected to an anesthesia delivery system:

2 Leave control dial engaged at »**T**« .

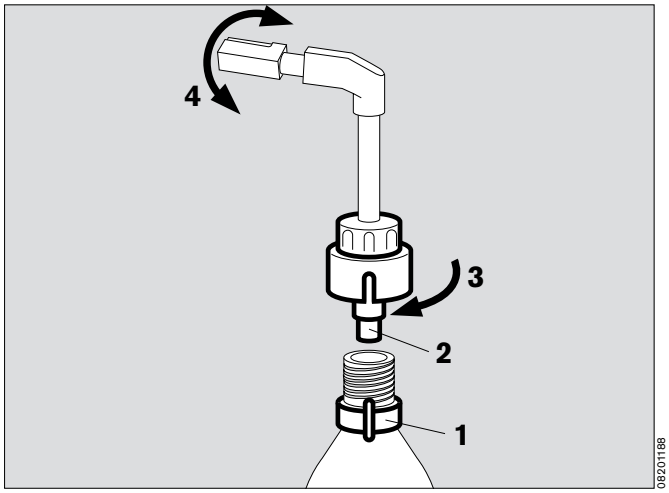


1 Only use anesthetic agent bottles with anesthetic agent-specific collars on the neck.

- Select a keyed filler adapter specific to the anesthetic agent – make sure any color coding or labeling on the keyed filler adapter corresponds to the anesthetic agent used.

2 Recommendation: Only use keyed filler adapters with check valve.

- Do not use keyed filler adapters or bottles which are damaged.



CAUTION!

Only use keyed filler adapters which meet the following interface requirements regarding Vapor keyed filling system:

Square section with

- flat and even sealing surface
- flat and even chamfer on front end of sealing surface
- no sharp edges between chamfer and sealing surface

Otherwise adapters may destroy seal of keyed filling system and/or leakage will occur. High forces trying to close the interface tightly may result in damage of the lever mechanism.

Recommendation: Use metal keyed filler adapters from Dräger.

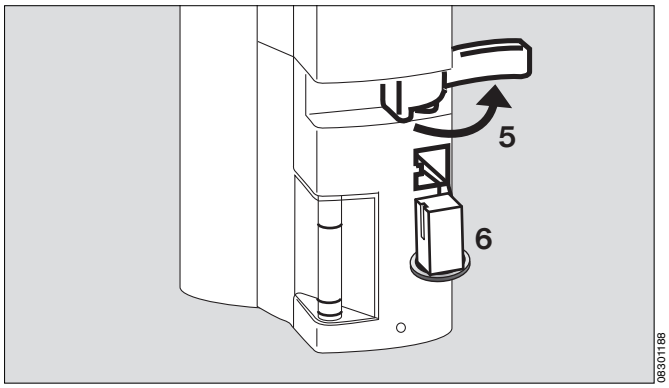
NOTE: New, sealed bottles that are partially empty may indicate a leak.

3 Screw keyed filler adapter firmly into anesthetic agent bottle.

WARNING!

If the connection between the filling adapter and the anesthetic agent bottle is not leak-tight, vaporizer can be overfilled and anesthetic agent vapor can escape. This may result in a health hazard.

4 Rotate square section of the keyed filler adapter so that holes are on the underside.



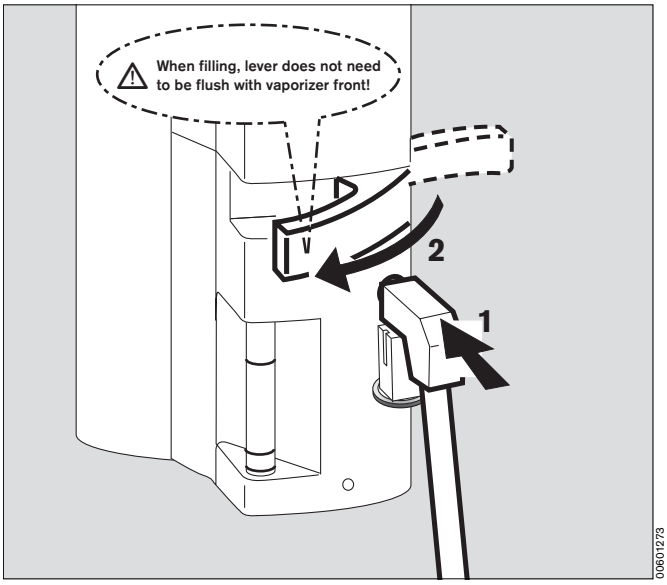
5 Swing lever out **slowly** so that the pressure in the Vapor can escape slowly.

6 Pull sealing block out completely and fold down.

- Hold anesthetic agent bottle below Vapor.
  The holes on the keyed filler adapter must be on the underside.

1 Push keyed filler adapter completely into opening of the filling device until it engages.

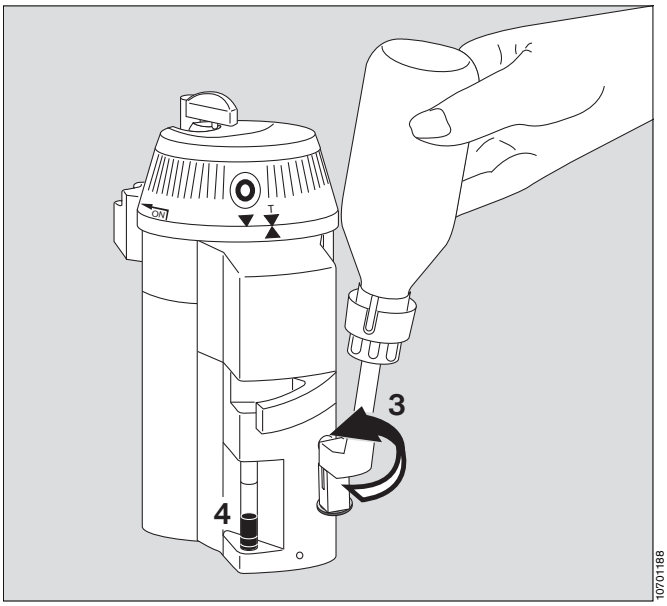
2 Swing lever back in and tighten – **do not use excessive force**.
Lever does **not** need to be flush with the front of the vaporizer.



WARNING!

Excessive force may damage seal and lever mechanism, and fresh gas and anesthetic agent vapor may escape. This may result in a health hazard.

3 Swing anesthetic agent bottle upside down **slowly**, and **hold** in this position.



WARNING!

A dropped anesthetic bottle may release significant quantities of anesthetic agent, resulting in a serious health hazard.

4 Check filling level on viewing glass.
When maximum mark is reached, flow stops automatically.

WARNING!

If keyed filler adapter has not been connected to the anesthetic agent bottle or to the Vapor tightly enough, anesthetic agent may continue to flow into the Vapor.[1)]

1) The seals on the Vapor and keyed filler adapter are parts subject to wear; check and replace, when necessary.

Fill to maximum mark only.
If the Vapor is filled above the maximum mark by a few millimeters, anesthetic agent will start to overflow through an overflow hole.

To finish the filling process:

1 Swing anesthetic agent bottle down.

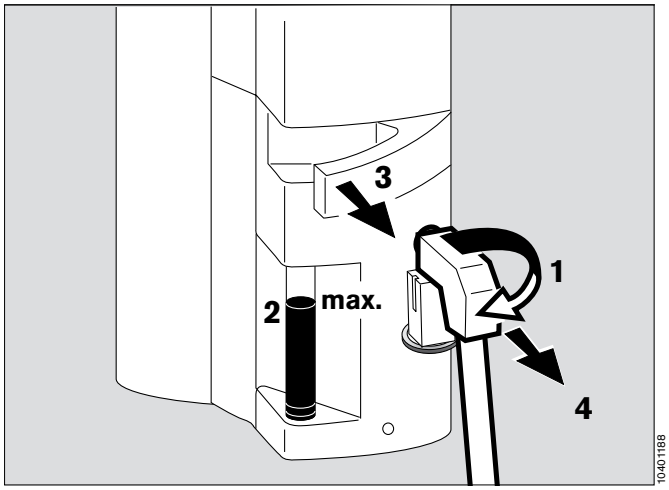
2 Check filling level on viewing glass – Vapor must be hanging **vertical** or standing upright during this check. The filling level must be visible and must not exceed the maximum mark.

If the maximum mark has been exceeded, there is a **risk of incorrect output concentration**, and excess anesthetic agent must be drained:

- Swing anesthetic agent bottle down.
- Allow anesthetic agent to flow back into the bottle until the level descends to the maximum mark.
  If necessary, see "Draining the Vapor", page 49.

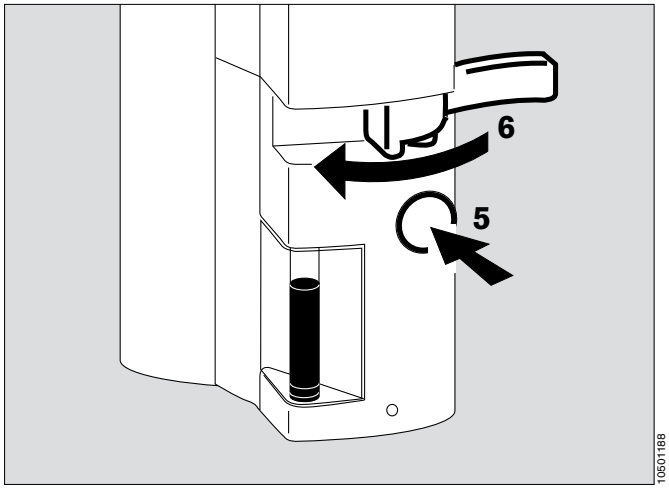
3 Swing lever out.

4 Pull the keyed filler adapter out.



5 Insert sealing block, push in **fully** and **keep pushed** in.

6 Swing lever back in.



WARNING!

If lever is not closed properly, fresh gas and anesthetic agent vapor may escape. This may result in a health hazard.

If lever cannot be **fully** closed, release lever and push sealing block in fully. If this is not done, the sealing block will not be leak-tight and the seal may become damaged.

- Unscrew keyed filler adapter.

WARNING!

Do not store anesthetic agent bottles with their keyed filler adapter screwed on. Anesthetic agent will escape. This may result in a health hazard.

- Close the bottle even if it is completely empty, or allow
- residues of anesthetic agent in the keyed filler adapter and in the anesthetic agent bottle to evaporate under a fume hood.

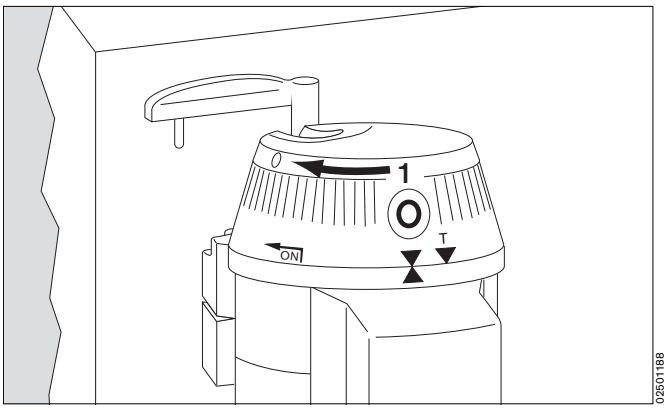
WARNING!

If anesthetic agent bottles are not closed properly, anesthetic agent vapor will escape into the ambient atmosphere. This may result in a health hazard.

Vapor with Quik Fil filling system

Heed all warnings on pages 22, 23.

If Vapor is connected to an anesthesia delivery system, leave control dial engaged at »**0**«.



When filling during operation:

- Fresh gas flow can remain as set.

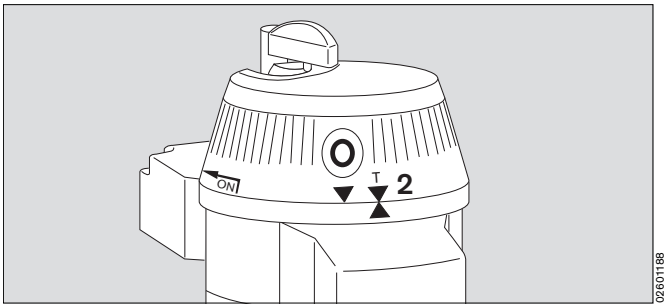
1 Set control dial to »**0**« –

WARNING!

When filling during operation, always wait for 5 seconds after setting control dial to »0«. This will allow for pressure to equalize in order to prevent fresh gas and anesthetic agent vapor from escaping.

If the Vapor is not connected to an anesthesia delivery system:

2 Leave control dial engaged at »**T**«.



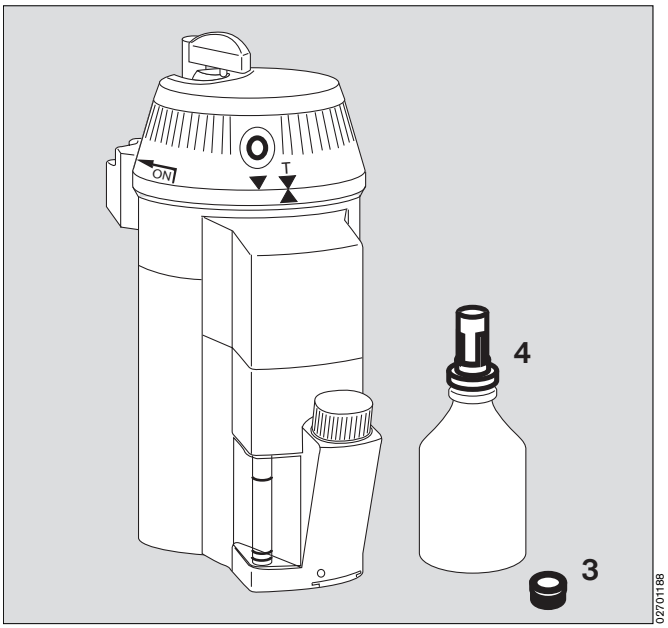
3 Unscrew the cap from the bottle adapter.

4 The bottle adapter must rest **securely** and **tightly** on the bottle and must not be damaged.

New, sealed bottles that are partly empty may indicate a leak.

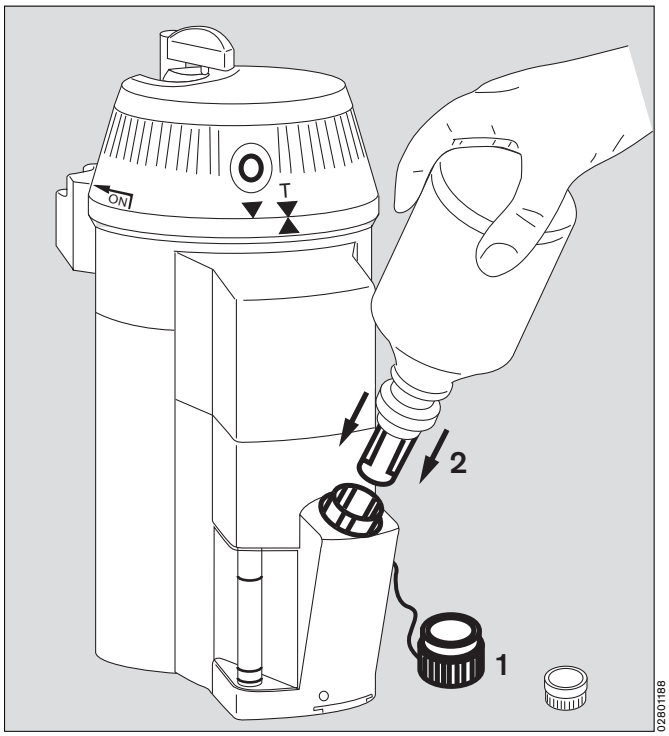
WARNING!

If the connection between the keyed filler adapter and the anesthetic agent bottle is not leak-tight, vaporizer can be overfilled and anesthetic agent vapor can escape. This may result in a health hazard.



1 Unscrew sealing cap on the filling system **slowly** so that any pressure in the Vapor can escape slowly.

2 Insert bottle so that the flanges install into the matching slots on the filling connector.
Only use bottles with correct flanges.
Observe color coding on the bottle and on the Vapor.



3 Push bottle into the filling connector to the stop and keep it pushed in.
Do not use excessive force and be careful not to twist the bottle.

4 Check the filling level on the viewing glass.
When the maximum mark is reached, flow stops automatically.

WARNING!

If keyed filler adapter has not been connected tightly enough to the anesthetic agent bottle or to the Vapor, anesthetic agent may continue to flow into the Vapor[1)].

1) The seals on the Vapor and keyed filler adapter are parts subject to wear; check and replace, when necessary.

Fill Vapor to maximum mark only.

5 **If the Vapor is filled above the maximum mark by a few millimeters, anesthetic agent will start to overflow through an overflow hole.**

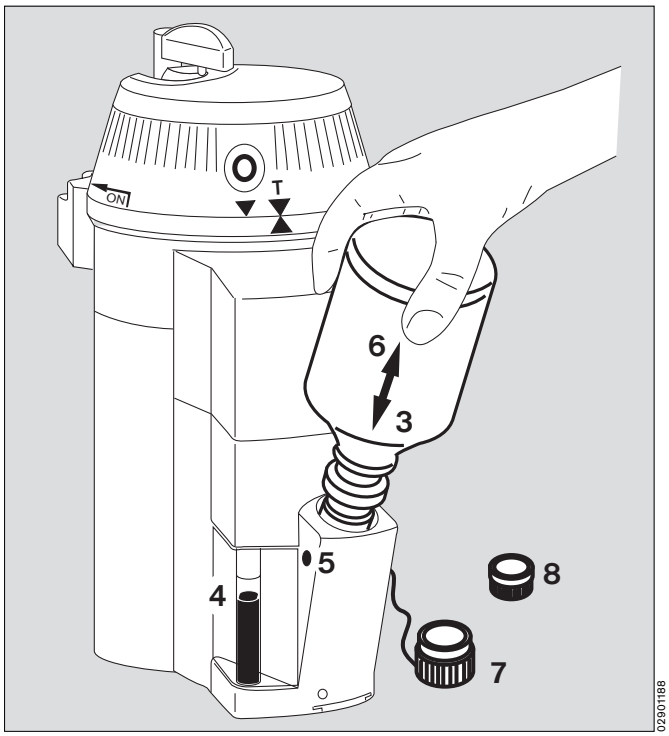
To finish the filling process:

6 Reduce pressure on the bottle and pull bottle out slowly.

4 Check filling level on the viewing glass – Vapor must be hanging **vertical** or standing upright during this check. The filling level must be visible and must not exceed the maximum mark.
If the maximum mark has been exceeded, there is a **risk of incorrect output concentration**, and excess anesthetic agent must be drained.

- Drain the Vapor at least to the maximum mark (see "Draining the Vapor", page 49).

7 **Tighten sealing cap firmly.**



WARNING!

Always make sure to tighten sealing cap firmly. If this is not done properly, fresh gas and anesthetic agent may escape when Vapor is switched on.

8 Screw cap onto bottle adapter. Always keep bottle closed.

Vapor with funnel filling system

Heed all warnings on pages 22, 23.
If the Vapor is connected to an anesthesia delivery system, leave control dial engaged at »**0**«.

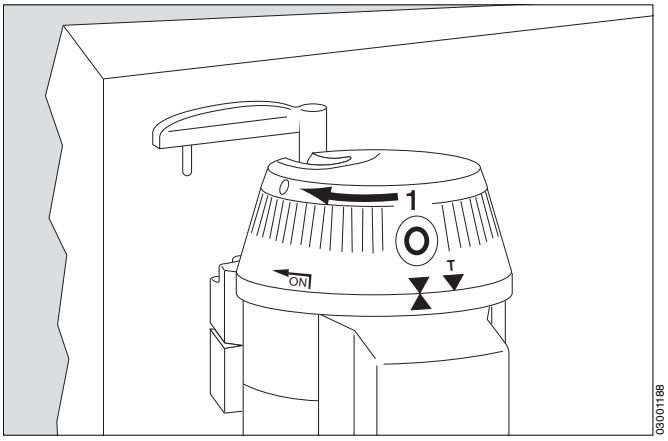
Filling during operation:

- Fresh gas flow can remain as set.

1 Set the control dial to »**0**« –

WARNING!

When filling during operation, always wait for 5 seconds after setting control dial to »0«. This will allow for pressure to equalize in order to prevent fresh gas and anesthetic agent vapor from escaping.



If the Vapor is not connected to an anesthesia delivery system:

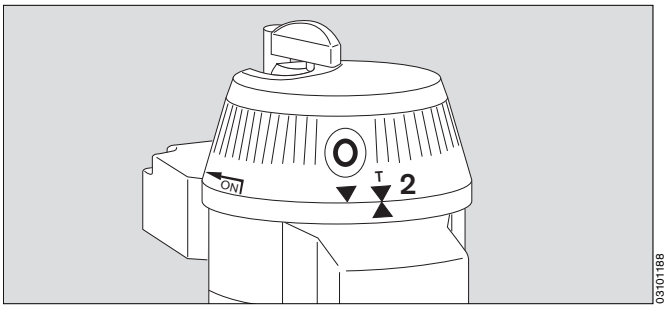
2 Leave control dial engaged at »**T**«.

- Use correct anesthetic agent bottle.
  The name of the anesthetic agent and the color coding on the Vapor and on the anesthetic agent bottle must correspond.

3 Unscrew cap from anesthetic agent bottle.

4 Unscrew sealing cap **slowly** from the filling inlet, so that any pressure in the Vapor can escape slowly.

5 Pour anesthetic agent slowly into the **inner** filling funnel.



WARNING!

When filling Vapor with funnel filling system, do not allow anesthetic agent to overflow. Do not pour between inner filling funnel and housing – anesthetic agent may overflow.

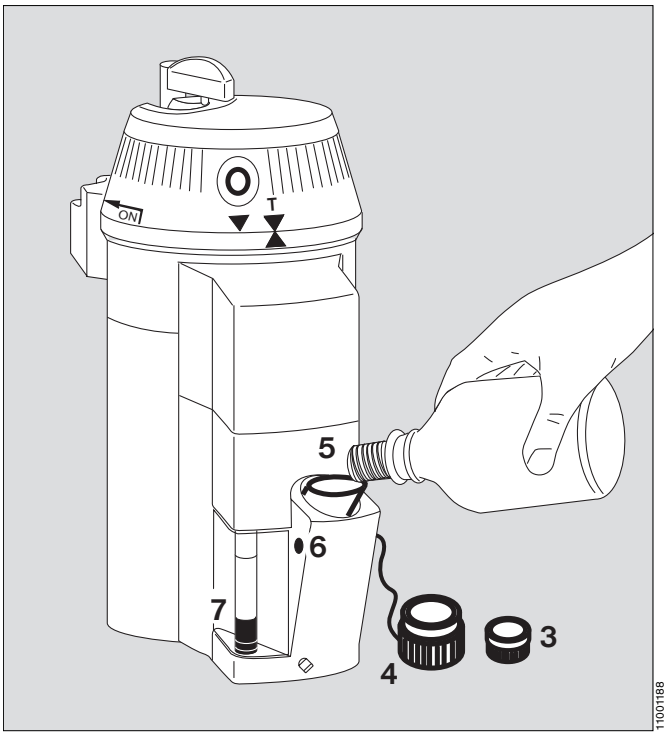
- Note filling level on viewing glass.
  Fill to maximum mark only.

If maximum mark has been exceeded:

6 **When Vapor is filled above maximum mark by a few millimeters, the anesthetic agent will start to overflow through an overflow hole.**

7 Check filling level on the viewing glass – Vapor must be hanging **vertical** or standing upright during this check. Filling level must be visible and must not exceed the maximum mark.
If maximum mark has been exceeded, there is a **risk of incorrect output concentration** and excess anesthetic agent must be drained.

- Drain the Vapor at least to the maximum mark (see "Draining the Vapor", page 49).



- **Tighten sealing cap firmly.**

WARNING!

Always make sure to tighten sealing cap firmly. If this is not done properly, fresh gas and anesthetic agent may escape when Vapor is switched on.

- Close bottle, even if completely empty, and allow any residues of anesthetic agent to evaporate under a fume hood or fan, if possible.

WARNING!

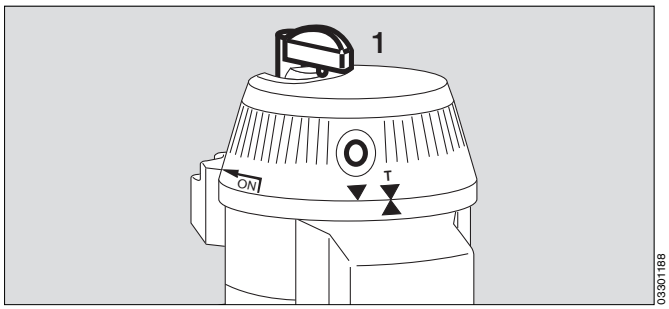
If anesthetic agent bottles are not closed properly, anesthetic agent vapor will escape into the ambient atmosphere. This may result in a health hazard.

Connecting the Vapor

The control dial must be engaged at »T«. – If it is not, check concentration before operation –
see "Transport, procedure after tilting", page 58.

Vapor with plug-in adapter

1 The locking lever must be in position over the control dial.

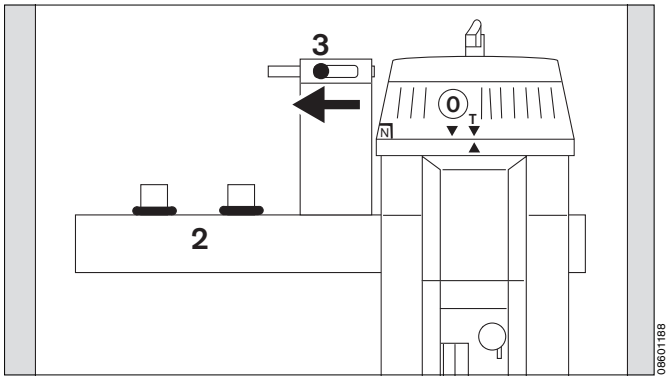


2 O-ring seals on both pins of the plug-in connector must be installed and undamaged. There should be no foreign matter on the plug-in connector.

Anesthesia delivery systems with several plug-in connectors:

Two plug-in connectors and Interlock 2:

3 Before attaching Vapor, slide selector lever on Interlock 2 away from Vapor.
If another Vapor has already been connected to the other plug-in connection and is in operation, it must first be set to »**0**«.

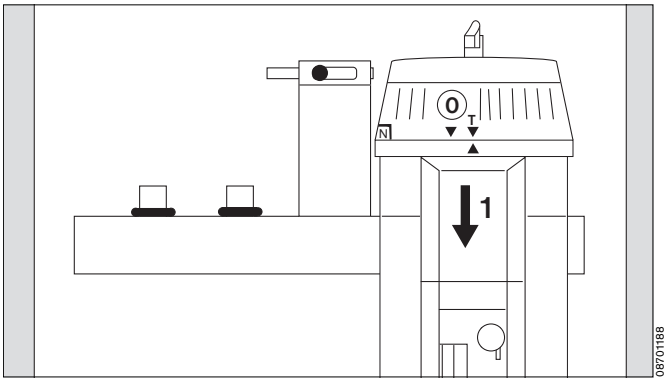


Several Selectatec-compatible plug-in connectors:

- Switch off vaporizers on other plug-in connectors.
  Set their control dial(s) to »**0**« or »**OFF**«.

- When several vaporizers are connected, they must always be right next to each other.
  For the Interlock to operate, it is essential that there is direct contact on the Interlock pin.
  For triple plug-in connectors with built-in transmission of safety locking between the two outer plug-in positions, the middle plug-in position may remain unoccupied.

1 Hold Vapor in a vertical position with both hands and carefully lower it onto the pins on the plug-in connector.



WARNING!

Take care not to injure fingers when lowering the Vapor onto its adapter.

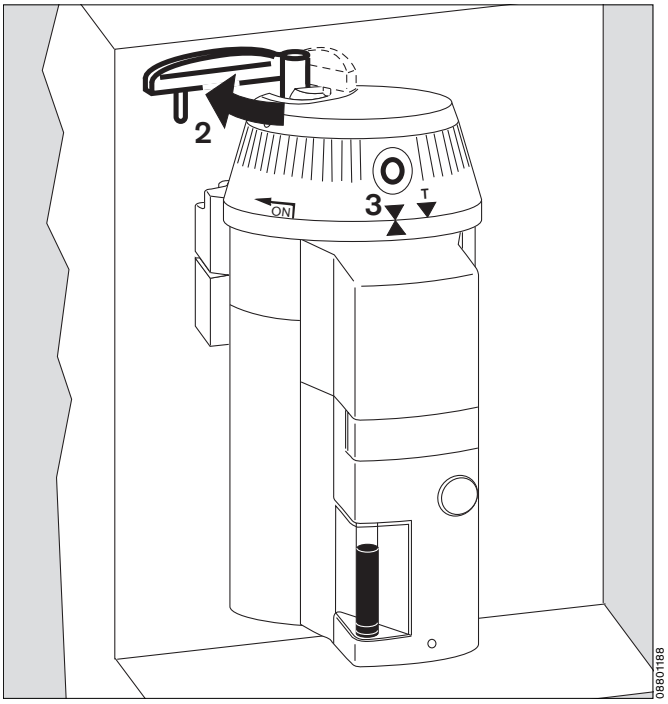
WARNING!

The plug-in adapter must be level and stable on the o-ring seals. If this is not the case, there may be a loss of fresh gas, leaks, excessively low output concentrations, or the Interlock locking device may jam.

If the plug-in adapter is not seated properly, remove Vapor (see "Disconnecting the Vapor", page 45), check positions of lever and stop-mechanism, and then reconnect Vapor.

2 Swing locking lever 90° clockwise until it engages. Verify that Vapor is secured and cannot be removed.

3 Press »**0**« button and set control dial to »**0**«.



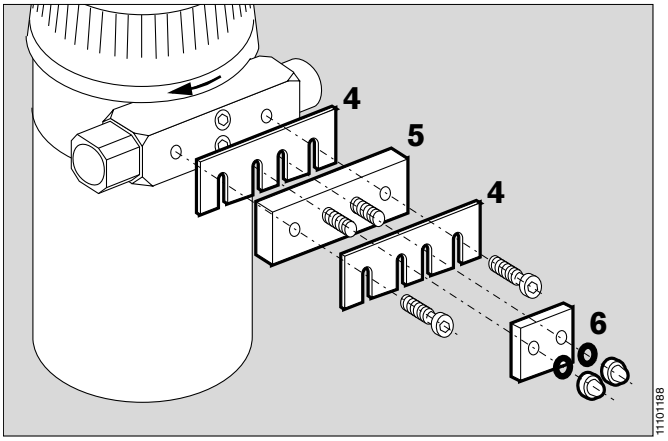
Vapor with tapered connectors without Interlock System

- Insert Vapor into fresh gas line.

4 For anesthesia delivery systems with rigid tapered connectors, adjustment plates may be used for alignment between connecting piece and connecting plate and/or connecting plate and anesthesia delivery system.
Ensure that the screws used are of adequate length – at least 4 engaged threads. If necessary, use longer screws with a strength of at least 500 N/mm^2.

5 Fasten connecting plate to connecting piece using M6 DIN 912-A4 cap screws, torque (7 ±0.5) Nm.

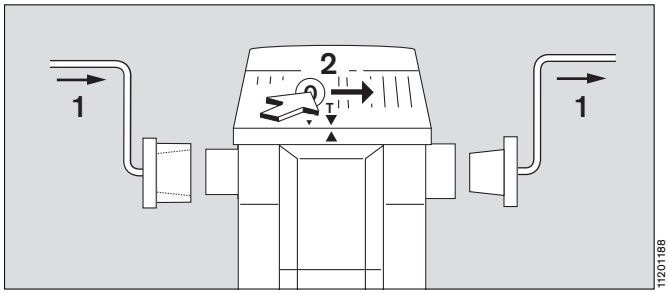
6 Tighten Vapor with clamping plate and two M6 DIN 1587M-A4 cap screws and two washers A6,4 DIN 125-A4.



WARNING!

Never use Vapor within a breathing circuit. Risk of incorrect output concentration and high resistance.

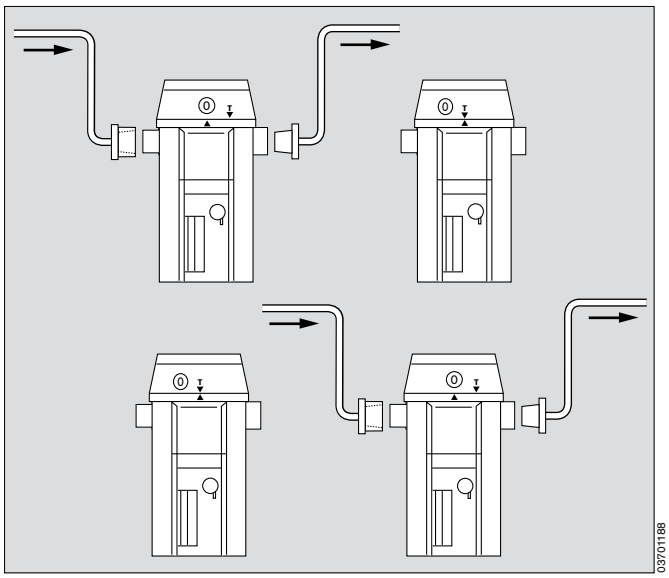
1 Connect gas inlet and outlet line to Vapor.



WARNING!

When connecting the Vapor, make sure that the direction of flow is correct and corresponds with arrow on the back of the Vapor (see page 21).

2 Press »**0**« button and set control dial to »**0**« until it engages.



WARNING!

Always secure a free-standing Vapor against tilting and falling. Risk of injury and of damage to the vaporizer.

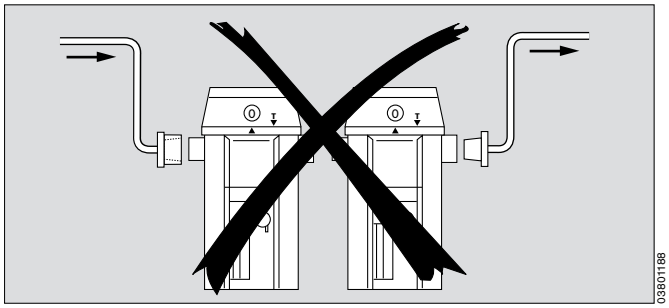
WARNING!

Make sure that only one Vapor is used at any one time and that only one Vapor is connected at any one time to prevent the delivery of mixtures or concentrations which are too high.

On the Vapor which is not being used;

- Press »**0**« button and move control dial to »**T**« until it engages.

When using several Vapors with tapered connectors:
Never connect Vapors in series.



WARNING!

If Vapors are connected in series without an Interlock system, there is a risk that several Vapors will be switched on and operational at the same time. If this happens, gas containing anesthetic agent from one Vapor would flow into the vaporizing chamber of another Vapor resulting in uncontrolled mixtures.

Operation in MRI fields

Due to the pneumatic principle and the low amount of ferromagnetic material, Vapor 2000 can generally be used in magnetic fields, i. e. in conjunction with nuclear spin tomography (MRI) together with anesthetic workstations suitable for MRI.
A test must be carried out prior to first use because the ferromagnetic parts in the magnetic field are subject to torques and forces which are not applicable under any condition as there is a variety of types and shields of MRI scanners.

The respective individual combination of Vapor, anesthetic workstation, and MRI scanner must be tested for proper functioning in the magnetic field with the anesthetic workstation at its intended position near the MRI scanner. The testing has to take into consideration all positions of the anesthesia workstation including Vapor in which it will be operated in the MRI theatre during daily use. The test must be carried out by trained and factory authorized technical service representatives for anesthetic machines and MRI scanners and application experts respectively.

Carry out the test of delivered concentration at 3 and 6 vol.% according to the section "Checking Readiness for Operation" subsection "Checking Concentration"
— outside the magnetic field,
— in the intended position within the magnetic field.
The tolerance between both measuring results is:
±0.1 vol.% at 3 vol.% and ±0.2 vol.% at 6 vol.%.

WARNING!

**If the measured value is not within the permissible range, do not use Vapor.
Risk of patient injury.**

If the Vapor is not permanently attached test the impact of the magnetic field on the tightness of the connecting system according to section "Operation", subsection "Checklist – Checks Before Each Use" paragraph "Leak-Tightness" to secure the proper mounting, connection and tightness of Vapor.

WARNING!

**If it is recognized that forces or torques from the magnetic field try to turn or pull the Vapor with respect to it's normal vertical position leckage may occur.
Do not use Vapor. Risk of patient injury.**

If the Vapor is not permanently attached also test the impact of the magnetic field on the proper function of the Interlocksystem according to section "Operation", subsection "Checklist – Checks Before Each Use" paragraph "Interlock system". The Interlock system must work properly.

WARNING!

**If it is recognized that forces or torques from the magnetic field try to turn or pull the Vapor with respect to it's normal vertical position malfunction of the interlock system may occur.
Do not use Vapor. Risk of patient injury.**

Record the test results and the approval of Vapor 2000/ anesthetic workstation for the respective position near the MRI scanner.
It is necessary to check additionally if the imaging of the MRI scanner is adversely affected by the Vapor and the anesthetic workstation.

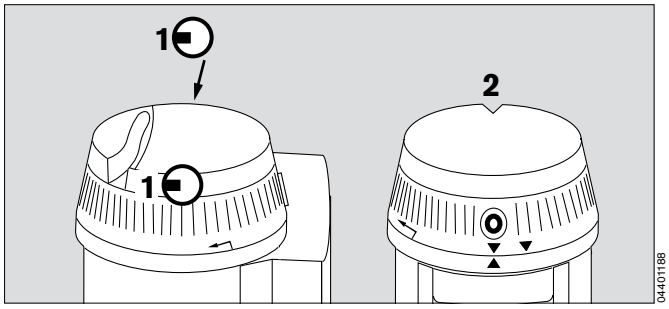
WARNING!

For operation in magnetic fields it is not permitted to connect the Vapor via hose connectors or tapered connectors with the anesthesia workstation.

Checking Readiness for Operation

Perform the following checks at least every six months; after prolonged shutdown; and each time after the anesthesia delivery system or the Vapor has been serviced.

- Previous inspection less than 6 months ago.
- Accompanying documents/Operating Instructions present.
- No damage to Vapor and no loose parts.
- Anesthetic agent labeling on Vapor, color code on control dial cap and other anesthetic agent-specific codings, when present (e.g. identification initials or codings on plug-in adapter), are all consistent (see page 23).
- Gas inlet and gas outlet are not soiled, dented, or damaged.
- Control dial engages at »**0**« setting as well as at »**T**« setting and cannot be turned without »**0**« button being pressed.
- After »**0**« button has been pressed, control dial can be turned right to the stop, close to highest concentration mark.

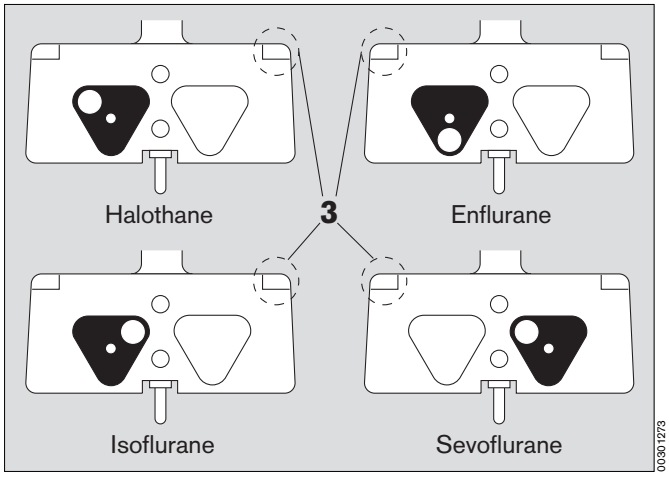


- Interlock disc rests firmly on control dial.

1 Interlock 2:
in both openings and undamaged.

2 Interlock NMD:
Notch is at the back when control dial set at »**0**«.

3 Plug-in adapters with milled corners must not be fitted to Vapor with an Interlock control dial cap NMD.



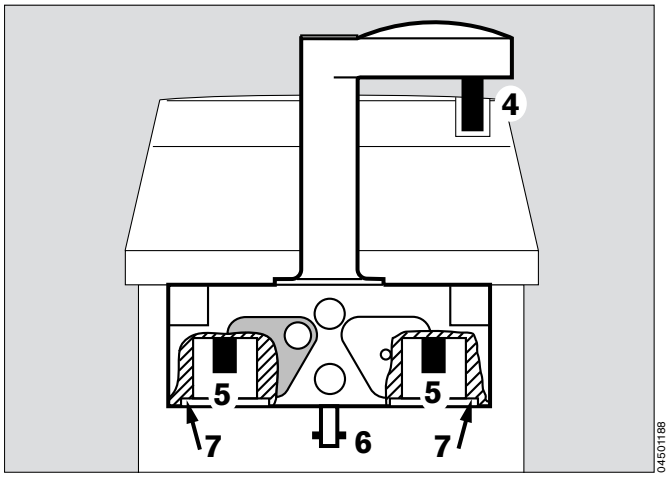
Plug-in adapter, DW-2000 and S-2000:
With the Vapor not connected to the plug-in connector:

- Turn locking lever to locking position – it must turn back automatically. Re-engage locking lever in control dial.

Plug-in adapter DW-2000:
Only use white plug-in adapter for Vapor 2000.

WARNING!

Vapor 19.n plug-in adapters, which are silver in color, must never be used on the Vapor 2000.



4 Drop-in pin on locking lever secure and straight.

5 Valve control pins both present.

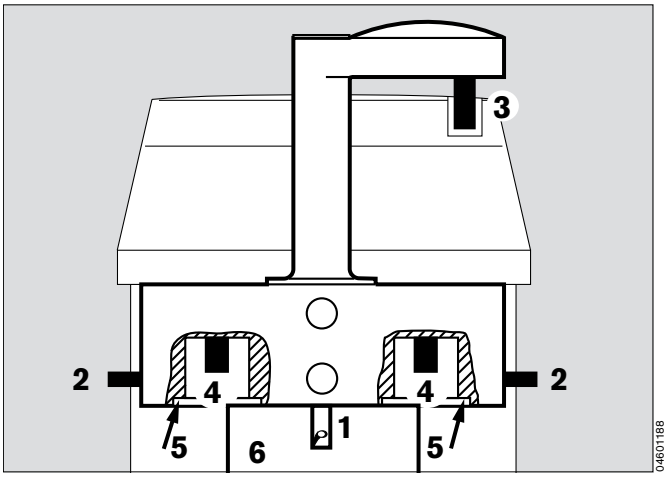
6 Transverse pin at the bottom of the locking lever is tight, in the center and not buckled or damaged.

7 Sealing surfaces undamaged.

Plug-in adapter S-2000:
Only use white plug-in adapters for Vapor 2000.

WARNING!

Vapor 19.n plug-in adapters, which are grey in color, must never be used on Vapor 2000.



1 Stop mechanism undamaged, not buckled.
2 Interlock pins undamaged, glide easily, and cannot be removed.
3 Drop-in pin on locking lever secure and straight.
4 Valve control pins both present.
5 Sealing areas undamaged.
6 Manufacturer's plate on the back of Vapor present and secure.

Tapered connector:

- Male taper connected to Vapor inlet.
- Female taper connected to Vapor outlet.
- Connector and sealing surfaces undamaged.

Permanent connection:

- Vapor fixed securely to connector.

Keyed filling system and Quik Fil filling system:

- Keyed filler adapter coded on both ends for the correct anesthetic agent. Seal on bottle connector present and undamaged.
- Only the correct keyed filler adapter fitted into the filling opening.
- The viewing glass is unstained. Any stains must be removed by trained and factory authorized service personnel.
- Anesthetic agent in viewing glass is not discolored. Halothane, for example, contains thymol to stabilize it. Thymol and other reaction products may gradually accumulate in the wick and the vaporizing chamber and color the Halothane yellow.
  If this has happened:
  — Drain off discolored anesthetic agent (see page 49 to page 53).
  — Refill to the maximum mark with fresh anesthetic agent (see page 23 to page 31), allow to interact for about 6 hours and then drain completely.
  — Dispose of drained anesthetic agent in accordance with local regulations.

If yellow discoloration persists, have wick replaced by trained and factory authorized service personnel.

- Check output concentration of anesthetic agent weekly, if not continuously monitored is (see page 37).
- Check Vapor in accordance with checklist, see page 39.

Checking Concentration

Check weekly if not continuously monitored.

Preparation

- Fill Vapor – at least half full between minimum and maximum mark.
- Allow the filled Vapor to warm up to room temperature of 20 to 24 °C.
- Wait long enough for the temperature to equalize – the time will vary depending on the temperature difference ΔT:

ΔT	up to ±2 °C	±6 °C	±10 °C	±20 °C
Hours	1	3	4	5

- Check anesthetic agent monitor. Perform zero calibration of monitor with the desired gas (Air or O_2).
- Connect monitor to fresh gas outlet or Y-piece. Make sure that all connections are leak-tight.
- Connect and start scavenging system.

Setting

- Switch off ventilator or set ventilation pressure to less than 5 cm H_2O.
- Set monitor to the anesthetic agent being used and to continuous measurement.
- Set flow between 2.5 and 4 L/min Air. Use O_2 if Air is not available.

Measuring

Check »**0**« and »**T**« marks, 1 vol.%, 4 vol.%, and at least 3 other concentrations.

- Adjust control dial.
- Read concentration after it has reached steady state.

Correcting measured values

Depending on carrier gas used:

– Air check: no correction required.

– O_2 check (see page 69): reduce the measured values as follows:

Measured value vol.%	Correction
<1.0	–0.05
1.0 to 2.0	–0.10
2.5 to 4.0	–0.20
5.0 to 8.0	–0.30

If the value displayed on the monitor is

— in % partial pressure: no correction required.
— in vol.%: convert to partial pressure:

$$\text{Concentration [\% partial pressure]} = \frac{\text{Measured value [vol.\%]} \cdot \text{atmospheric pressure [cm } H_2O\text{]}}{1013 \text{ cm } H_2O}$$

Determining permissible range

See accuracy data (see "Technical Data", page 61) for the permissible range of output concentration.

Determine the monitor tolerance.

The permissible tolerance for the Vapor output concentration reading is the sum of both tolerances.

Test result

If the corrected measured value is within the permissible range of output concentration, the Vapor may be put into operation.

WARNING!

If the corrected measured value is not within the permissible range, do not use Vapor.
Risk of patient injury.
Have Vapor checked by trained and factory authorized service personnel.

After the test

- Switch off Vapor by turning control dial clockwise to »**0**« until it engages.

If the Vapor is not connected to an anesthesia delivery system:

- Press »**0**« button and engage control dial at »**T**«.
  With plug-in adapters, engage locking lever in the control dial.
- Switch off the Air or O_2 flow.

Example of concentration test:
Halothane Vapor is being tested at 3 % setting.
Measured value is 3.58.
Measurement was carried out using O_2.
So correct the measured value of 3.58 by –0.2 = 3.38.
Monitor display in partial pressure, so no correction required.
The permissible range is ±20 % rel. of set value,
i.e. 2.4 to 3.6 % partial pressure.
The Technical Data for the monitor gives an accuracy of ±5 %, i.e. a tolerance of ±0.18 % partial pressure for a measured value of 3.58 %.
The permissible range is, therefore, extended by this amount from 2.22 to 3.78 % partial pressure.
The corrected measured value of 3.38 is within the permissible range.

Operation

Checklist – Checks Before Each Use

Pre-conditions

- Operating parameters (e.g. temperature) are within the specified operating range – otherwise, wait for temperature to equalize with ambient temperature (see page 56).

WARNING!

High temperatures at low atmospheric pressures (high altitudes) may result in an uncontrolled excessive dosage (see page 67).

- Operation at an angle,
  e.g. in portable anesthesia delivery systems:

WARNING!

An unsecured Vapor tilted at an angle of more than 10° may tip over.
If a Vapor is operated at an angle of more than 30°, uncontrolled concentrations may occur. (see "Transport, procedure after tilting", page 58)

Connections, plug-in connectors/plug-in adapters may leak when the Vapor is tilted at excessive angles.

The filling level shown in the viewing glass will not be correct when Vapor is used at an angle. This may lead to overfilling.

- The anesthesia delivery system is prepared in accordance with the Operating Instructions and the anesthetic gas scavenging system is connected.
- The anesthetic agent monitor is switched on and set to the correct anesthetic agent. Alarm limits are set.

WARNING!

Dräger recommends monitoring concentration using a continuously measuring monitor with an alarm system to detect deviations from set concentration, leaks, or incorrect filling, particularly for Vapors with funnel filling system. For this reason, monitors should be used which can differentiate between different anesthetic agents. The capability of the monitor should be verified prior to its use.

Checklist – Checks Before Each Use

WARNING!

When using Low Flow and Minimum Flow, the concentration in the breathing system may deviate significantly from Vapor setting. For this reason, measurement of inspiratory and/or expiratory anesthetic agent concentration is essential.

Operation in magnetic field
Vapors must not be changed or left unsecured in magnetic fields.

WARNING!

Vapor can be moved by magnetic attraction. Risk of injury. Only use anesthetic delivery systems and accessories designed for use in magnetic fields.

WARNING!

For operation in magnetic fields the combination of Vapor, anesthesia workstation, and MRI- (MRT, NMR, NMI) scanner must be tested by experts (trained and factory authorized technical service representatives for anesthetic machines and MRI scanners and application experts respectively) prior the first use to ensure proper Vapor and interface function in the specific magnetic fields. Otherwise uncontrolled concentration and/or leakage and/or malfunction of the interlock system may occur (see page 34). The testing has to take into consideration all positions of the anesthesia workstation including Vapor in which it will be operated in the MRI theatre during daily use. Additionally it is necessary to check if the imaging of the MRI scanner is adversely affected by the Vapor and the anesthesia workstation.

- Oxygen monitor is switched on and alarm limits are set.

WARNING!

Dräger recommends use of a continuously measuring oxygen monitor with alarm system for detecting insufficient supply of oxygen, e.g. due to leaks.

Setting/checking

- Filling level in the viewing glass is between the minimum and maximum marks – must not exceed maximum mark.
- Filling system:
  - Keyed filling system: sealing block is in place and flush, and lever is locked.
  - Quik Fil filling system or funnel filling system: Sealing cap is closed and tightened.
- Connection system:
  - Plug-in connector: plug-in adapter is level on the seals. The locking lever is swung to the left. Vapor is secure and hanging vertically on machine when viewed from front and side.
  - Other connection systems: Vapor is connected firmly and securely on the anesthesia delivery system. Vapor is suspended or standing upright and is secured against tilting or falling.
- Direction of flow corresponds to arrow.
- For multiple connectors:
  - All connectors are occupied, or if not,
  - any unoccupied permanent and tapered connectors or plug-in adapters without valve function, must be closed for operation.

WARNING!

If unoccupied connectors are open, fresh gas and anesthetic agent vapor will escape and interrupt supply to the patient.

- Only one vaporizer is connected at a time, or if not:
- check that there is an Interlock system on the vaporizer and anesthesia delivery system, and that it is of same type.

WARNING!

A malfunctioning Interlock may endanger the patient by causing overdosing or a mixture of anesthetic agents.

- Fresh gas flow must be switched off.

- Check each connected vaporizer as follows:
  - Set vaporizer to any concentration.
  - All other vaporizers must be switched off, locked in their »**0**« positions, and impossible to switch on.
  - If there is an anesthetic agent vapor identification system, check that the identification system shows the correct anesthetic agent.

WARNING!

If no pre-use concentration checks are performed, an incorrect concentration may be displayed.

- Switch vaporizer off – set control dial to »**0**«.
- Check that the Vapor, connector and fresh gas lines are leak-tight at these settings (see Operating Instructions for your anesthesia delivery system):
  - control dial setting »**0**« and »**T**«
  - control dial setting ≥0.2 vol.%.

Rinse breathing system with fresh gas before connecting patient.

Do not operate the Vapor unless all checks have been completed successfully.

Any repairs must be performed by trained and factory authorized service personnel.

Adjusting Concentration of Anesthetic Agent

- Before adjusting Vapor, set fresh gas flow on the anesthesia delivery system.

If the control dial is set to »**T**«;

- Press »**0**« button, set control dial to »**0**«, and wait 5 seconds for pressure to equalize.

1 **Press** »**0**« button and

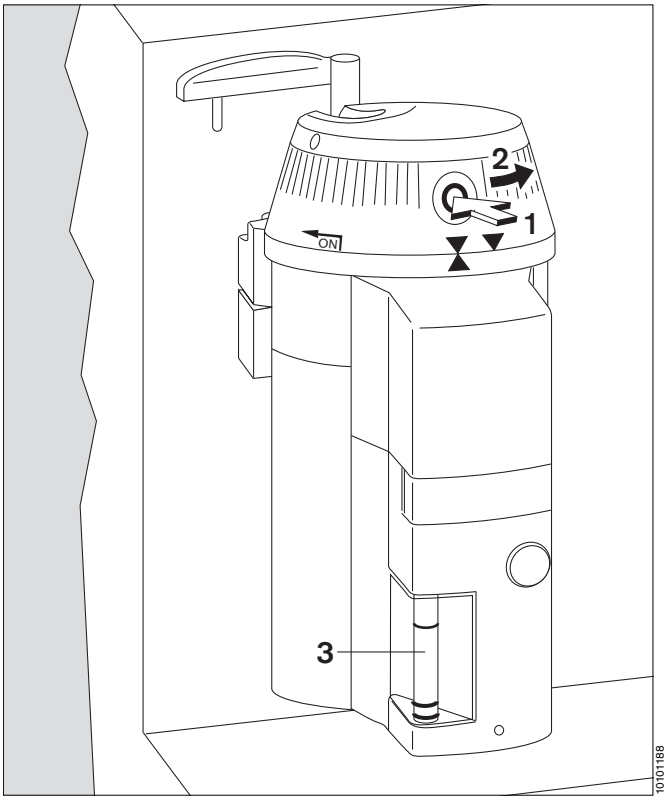
2 Turn control dial counterclockwise to the desired anesthetic agent concentration.

If it is not possible to set the concentration:
Do not force control dial.
Check that all other connected vaporizers are set to »**0**« or »**OFF**« and that Interlock system is operational.

WARNING!

Do not set the control dial between »0« and »ON« (i.e. below 0.2 vol.%).
In this range concentration is not defined.

3 Check filling level on viewing glass regularly. It must be visible between the minimum and maximum marks.
If filling level is below minimum or above maximum, do not use Vapor. The Vapor could be empty or overfilled, and the output concentration could be incorrect.



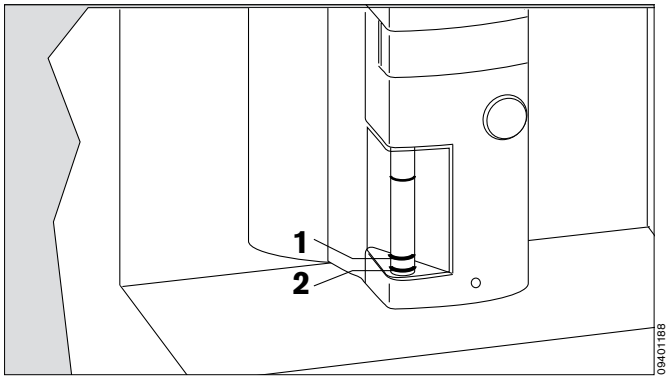
1 When the mark above the minimum mark is reached, the Vapor may be refilled with 250 mL (standard anesthetic agent bottle).

2 When the minimum mark is reached, (at the latest), fill Vapor (see “Filling the Vapor”, page 23 to page 31).

If the anesthetic agent monitor shows implausible values, check the Vapor for incorrect filling (particularly Vapors with funnel filling system), and check the monitor for wrong settings.

During prolonged operation with both a high flow of fresh gas and a high concentration, the concentration administered may decrease.
Be careful about temperature range (see page 61).

An anesthesia delivery system may be moved at the workplace with the Vapor switched on.



WARNING!

Abrupt movements of the Vapor or tilting the Vapor more than 30° can cause incorrect output concentration.

Changing Anesthetic Agent

- Set Vapor being used to »**0**«.
- Switch anesthetic agent monitor to the new anesthetic agent.

If only one Vapor is connected or if one of the connected Vapors is to be replaced:

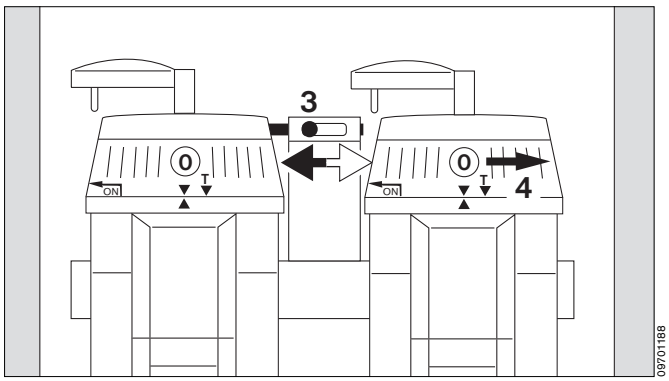
- Disconnect Vapor (see page 45).
- Connect new Vapor (see page 31).

Two Vapors with Interlock 2:

3 Slide selector lever on Interlock 2 toward the Vapor that was being used.

On the Vapor to be used:

4 Press »**0**« button and set control dial to the desired anesthetic agent concentration.



Ending Administration of Anesthetic Agent

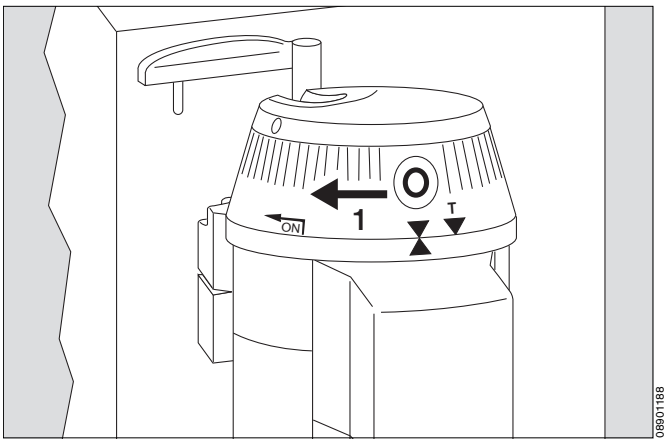
1 Switch Vapor off by turning control dial clockwise until it engages at »**0**« to prevent it being switched on accidentally.

Then, if required:

- Switch off fresh gas flow on the anesthesia delivery system.

WARNING!

Never switch off fresh gas flow before the Vapor is switched off. A Vapor must never be left switched on without a fresh gas flow, because high-concentration anesthetic vapor may leak into machine lines and ambient air, causing damage to materials and health risks.



End of Use

If the Vapor is not going to be used for up to six months, it may remain filled;

If the Vapor is not going to be used for more than 6 months, see "Shut-Down", page 49.

If the Vapor remains on the machine:

- For intervals of more than one week, anesthetic agent loss from the vaporizer chamber can be minimized by using the »**T**« setting.
- The locking lever on the plug-in adapter should remain in the left (locked) position.
- Keep Vapor within the permissible temperature range (see page 61).
- Observe expiration date of anesthetic agent.

If the Vapor does not remain on the machine:

- see "Disconnecting the Vapor", page 45, and see "Transport of Filled Vapors", page 46.

Disconnecting the Vapor

WARNING!

Take care not to drop Vapor. Do not use Vapor if it has been dropped. Damage may cause incorrect output concentration.
Do not carry Vapor by the control dial, control dial cap, or locking lever on plug-in adapter.
Risk of injury.

Disconnect Vapor only when control dial is set at »T«.

Disconnecting the Vapor at any other control dial setting may result in incorrect output concentration and/or cause anesthetic agent vapor to escape.

Place Vapor only on firm even surfaces or hang from stable brackets to prevent damage to Vapor or injuries.

In magnetic fields Vapor can be moved by magnetic attraction. Risk of injury.

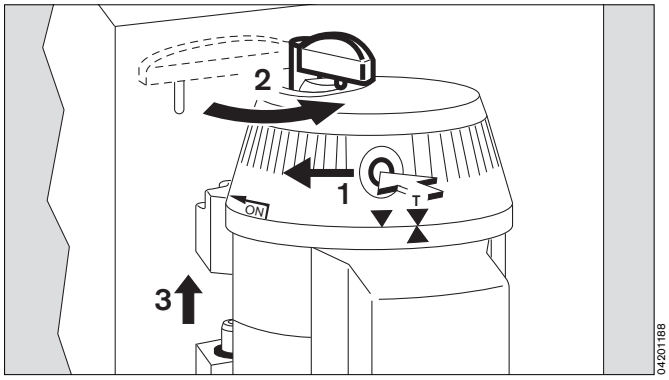
For plug-in connectors

- If necessary, set the control dials of adjacent anesthetic vaporizers to »**0**« or »**OFF**«.
- On the anesthesia delivery systems with two plug-in connectors and Interlock 2:
  Slide selector lever away from the Vapor that is being disconnected.

1 Press »**0**« button and turn control dial clockwise to »**T**« until it engages.

2 Turn locking lever 90° counterclockwise to engage it in the control dial.

3 Using both hands, carefully lift Vapor off the plug-in connector.



WARNING!

For plug-in connectors without valves, the fresh-gas supply is disconnected when the Vapor has been lifted off the plug-in connector. Fresh gas and anesthetic agent vapor may escape in this situation.

WARNING!

When operating an anesthesia delivery system with several vaporizers and Interlock S, Interlock S may not function effectively when one vaporizer is disconnected.

For tapered connectors

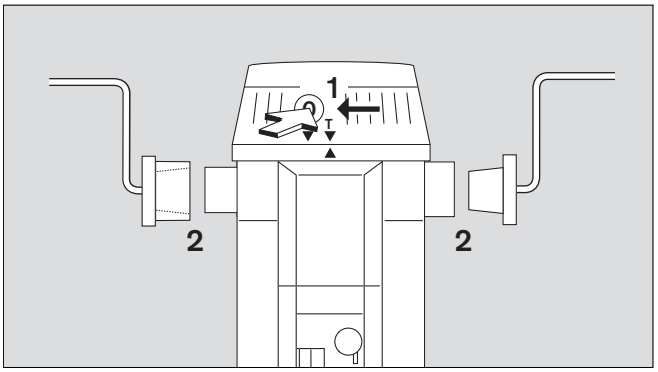
1 Press »**0**« button and turn control dial clockwise to »**T**« until it engages.
2 Detach gas supply and gas delivery lines from Vapor.

- The Vapor can now be disconnected.

WARNING!

When using tapered connectors, disconnecting the vaporizer will disconnect the fresh gas line. Fresh gas and anesthetic agent vapor may escape.

- In order to allow the continued flow of fresh gas to the breathing system, the gas supply line and the delivery line must be connected together securely.



For permanent connections

Only trained and factory authorized service personnel may remove Vapors with permanent connections.

WARNING!

Removal of Vapors with permanent connections in magnetic fields is not permitted. Ferromagnetic screws and tools and Vapors itself can be moved by magnetic attraction. Risk of injury.

Transport of Filled Vapors

The Vapor may be transported by itself or with a transportable anesthesia delivery system.

Transport refers to moving the Vapor as part of normal clinical operation, not storage or shipping.
For information on storage, see page 54,
For information on shipping, see page 54.

Transport only when ambient conditions are in accordance with "Technical Data – Shutdown" (see page 61).

An anesthesia delivery system may be moved at the workplace with the Vapor switched on.

WARNING!

Abrupt movements of the Vapor or tilting the Vapor more than 30° can cause incorrect output concentration.

Anesthesia delivery systems with securely fastened Vapors may be moved within or between buildings with the control dial set at »**0**«, if there is no risk of tilting by more than 30°.

WARNING!

When Vapor is tilted at an angle of more than 30°

- **— anesthetic agent may overflow when control dial is set at »0«. Risk of health hazard.**
- **— when control dial is set above »0«, anesthetic agent may leak and get into the flow control system causing excessively high or low concentrations when Vapor is used the next time.**

Disconnect detachable Vapors from anesthesia delivery systems and transport separately.

For Transport – control dial must always be engaged at »T«.

Always verify that the Vapor is appropriately secured against falling every time it is transported, in compliance with the Operating Instructions for the anesthesia delivery system, and that it is packed securely to prevent damage.

It is recommended that Vapors are kept in an upright position even though other positions are permitted with control dial set at »**T**«.

Care

CAUTION!

Do not immerse Vapor or keyed filler adapter in detergents.

Do not allow detergent to penetrate under the control dial.

Do not allow detergents to enter the gas inlet or outlet, or the filling system.

Do not sterilize Vapor or keyed filler adapter. Damage inside may cause incorrect output concentration.

Do not use solvents on Vapor.

WARNING!

Allowing liquids other than specified anesthetic agents to get into the Vapor may cause device malfunction and patient injury.

WARNING!

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

CAUTION!

Many materials are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately apparent.

Cleaning

Wipe heavy stains off with disposable cloth.

Disinfecting

Use surface disinfectants for disinfection. For reasons of material compatibility use disinfectants based on:

— aldehydes,
— alcohols,
— quaternary ammonium compounds.

Ensure that all disinfectants are registered with the U.S. Environmental Protection Agency for use as intended. Always follow the instruction labels specifically with respect to prescribed concentrations and the necessary exposure times.

Do not use preparations which are based on

— halogen-releasing compounds,
— strong organic acids,
— oxygen-releasing compounds.

Shut-Down

Draining the Vapor

WARNING!

Take care not to spill anesthetic agent.
Do not inhale anesthetic agent vapor.
Possible health risk.

Recommendation: Drain Vapor using suitable scavenging as small amounts of anesthetic agent vapor will always escape.

While draining, do not contaminate or mix anesthetic agents.

WARNING!

Anesthetic agent which has been drained off must be handled, stored and disposed of as a drug according to institutional policy and in accordance with all federal, state, and local regulations. Failure to do so will pose a risk of administering incorrect anesthetic agents or mixtures.

- **Place Vapor upright or suspend it vertically,** so that all the anesthetic agent can drain off.

Vapor with keyed filling system

If the Vapor is connected to an anesthesia delivery system:

1 Control dial must be engaged at »**0**«.

If the Vapor is **not** connected to an anesthesia delivery system:

2 The control dial should remain engaged at »**T**«.

3 Hold an **anesthetic agent-specific** bottle for the appropriate agent below the drainage outlet at the bottom of the filling device.

WARNING!

To prevent dangerous mixtures of anesthetic agents, always verify that the anesthetic agent name and the color coding on the Vapor correspond to those on the anesthetic agent bottle.

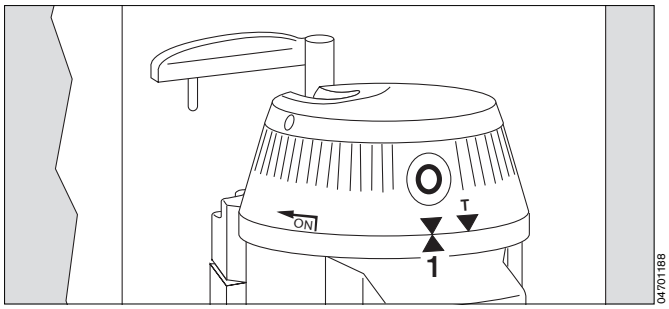
4 Set control dial at »**T**«, swing lever out. The sealing block should slide forward.

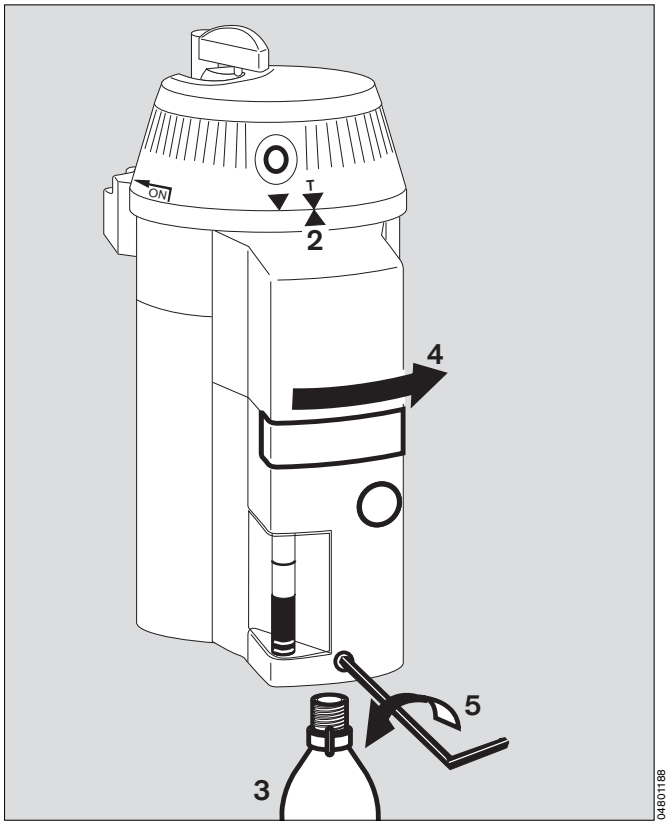
5 Using a 2.5 mm Allen key, open the drainage valve by turning it one or two times counterclockwise.

WARNING!

Do not use ferromagnetic keyed filler or drain adapter or tools when the filling or draining procedure is carried out in magnetic fields. Ferromagnetic adapter or tools can be moved by magnetic attraction. Risk of injury.

NOTE: Dräger metal keyed filler adapter which are labeled with "MRI" are not ferromagnetic.





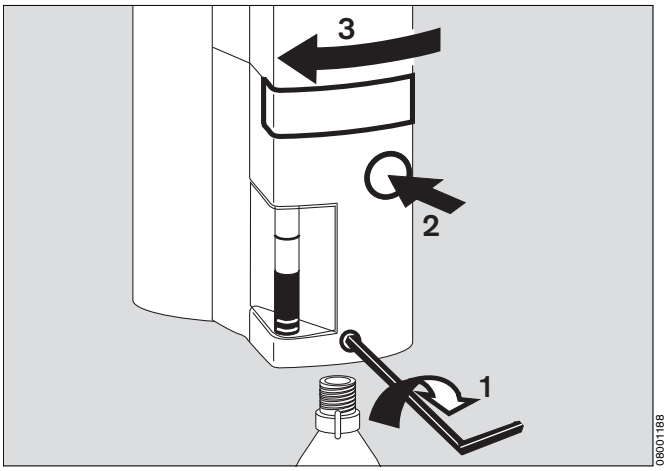
- Drain anesthetic agent until the viewing glass is empty and no more anesthetic agent flows into the bottle.
  If the anesthetic agent in the wick also needs to be removed, see "Flushing the Vapor", page 53.

WARNING!

Do not fill anesthetic agent bottles to the very top. This can lead to a significant amount of anesthetic agent escaping.

If necessary, close the drainage valve before the bottle is full and repeat procedure using a second bottle.

1 Close drainage valve by turning it clockwise.
2 Push sealing block in **fully** and **keep it pushed in**.
3 **Swing lever in.**



WARNING!

If the lever is not closed properly, fresh gas and anesthetic agent vapor may escape. This may result in a health hazard.

If the lever cannot be fully closed, release the lever and push the sealing block in **fully**. If this is not done, the sealing block is not leak-tight, and the seal may be damaged.

- Close anesthetic agent bottle.

WARNING!

If anesthetic agent bottles are not closed properly, anesthetic agent vapor will escape into the ambient atmosphere. This may result in a health hazard.

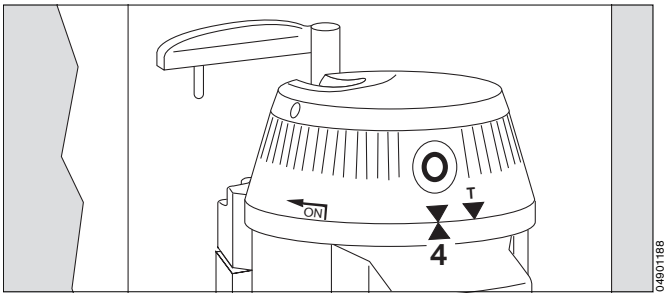
- Mark bottle "Used anesthetic agent".
  Recommendation: **Do not re-use**.

Vapor with Quik Fil filling system

Heed WARNINGS on page 49.

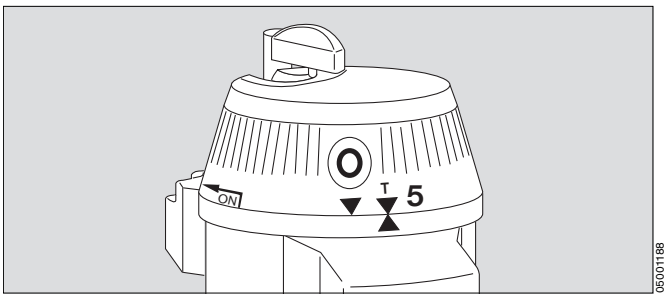
If the Vapor is connected to an anesthesia delivery system:

4 Control dial must be engaged at »**0**«.



If the Vapor **is not** connected to an anesthesia delivery system:

5 Control dial should remain engaged at »**T**«.



- Use only undamaged bottles and Quik Fil drain adapter.

WARNING!

The Quik Fil drain adapter must be flush and secure on the bottle. Otherwise significant quantities of anesthetic gas may escape.

- Use an **anesthetic agent-specific** bottle for the appropriate agent.

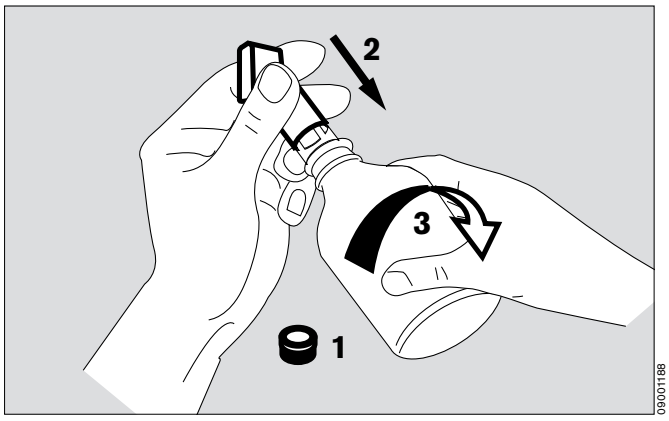
WARNING!

To prevent dangerous mixtures of anesthetic agents, always verify that the anesthetic agent name and the color coding on the Vapor correspond to those on the anesthetic agent bottle.

1 Unscrew cap from bottle adapter.

2 Fit slots on the socket of the drainage dish onto the corresponding ridges on the bottle adapter.

3 Push drain adapter against the bottle and turn the bottle. Screw upwards tightly.



WARNING!

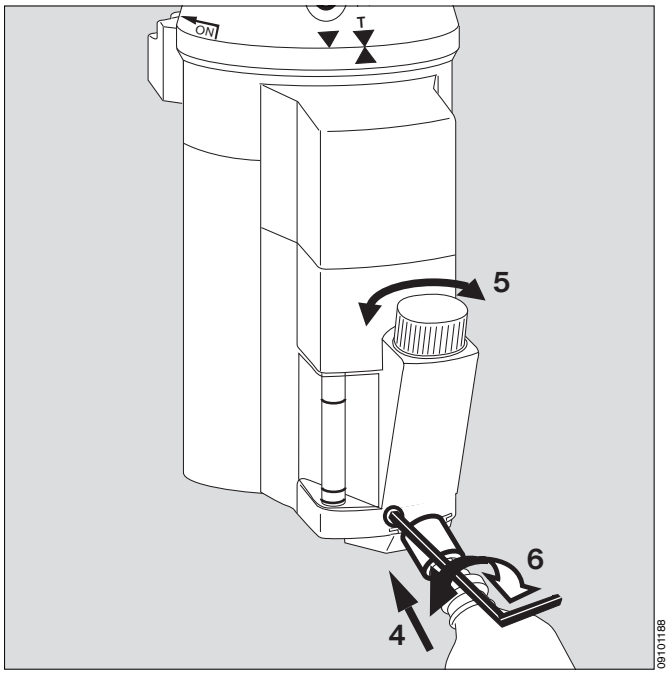
If anesthetic agent bottle is not screwed on tightly, the valve in the bottle will not open and anesthetic agent may leak during draining. This may result in a health hazard.

4 Push the drain adapter into the slot on the filling system **to the stop** and hold the bottle in this position during draining.

5 Set control dial to »**T**« and open the sealing cap on the filling device.

6 Using a 2.5 mm Allen key, open drainage valve by turning it one or two times counterclockwise, taking care that no anesthetic agent overflows from the drain adapter. If necessary, close drainage valve slightly.

- Drain anesthetic agent until the viewing glass is empty and no more anesthetic agent flows into the bottle. If anesthetic agent in the wick also needs to be removed, see "Flushing the Vapor", page 53.



WARNING!

Do not fill anesthetic agent bottles to the very top. This can lead to a significant amount of anesthetic agent escaping.

If necessary, close drainage valve before the bottle is full and repeat procedure using a second bottle.

- Close drainage valve by turning clockwise.
- Pull out bottle and keep upright.
- **Unscrew the drain adapter from the bottle; otherwise the bottle valve will not close and anesthetic agent may evaporate or spill out.**
- **Screw the sealing cap on tightly**

WARNING!

If sealing cap is not screwed on tightly, fresh gas and anesthetic agent may escape.

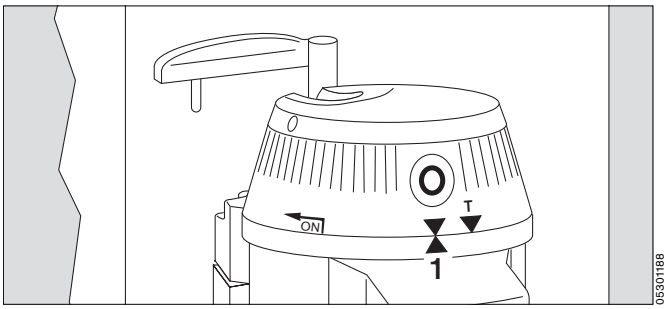
- Screw cap onto the bottle adapter.
- Mark bottle "Used anesthetic agent".
  Recommendation: **Do not re-use.**

Vapor with funnel filling system

Heed WARNINGS on page 49.

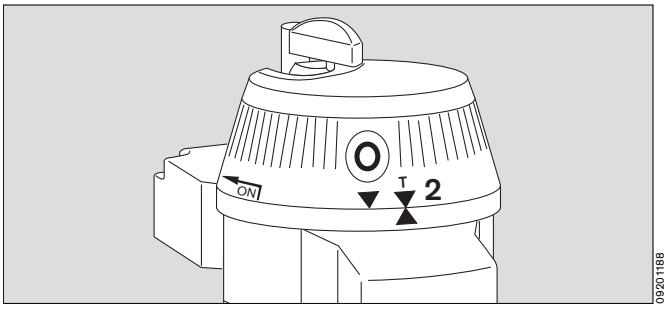
If the Vapor is connected to an anesthesia delivery system:

1 Control dial must be engaged at »**0**«.

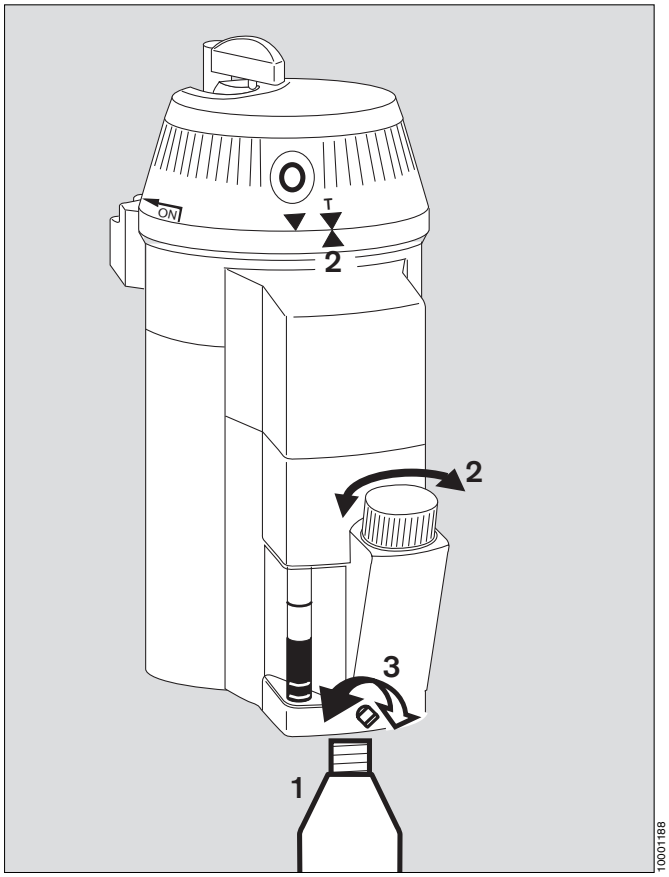


If the Vapor is **not** connected to an anesthesia delivery system:

2 Control dial should remain engaged at »**T**«.



1 Hold an **anesthetic agent-specific** bottle for the appropriate agent below the drainage outlet.



WARNING!

To prevent dangerous mixtures of anesthetic agents, always verify that the anesthetic agent name and the color coding on the Vapor correspond to those on the anesthetic agent bottle.

2 Set control dial to »**T**« and open the sealing cap on the filling device.

3 Open drainage valve by turning it one or two times counterclockwise.

- Drain the anesthetic agent until the viewing glass is empty and no more anesthetic agent flows into the bottle. If the anesthetic agent in the wick also has to be removed, see "Flushing the Vapor", page 53.

WARNING!

Do not fill anesthetic agent bottles to the very top. This can lead to a significant amount of anesthetic agent escaping.

If necessary, close the drainage valve before the bottle is full and repeat the procedure using a second bottle.

3 Close drainage valve by turning it clockwise.

- Close anesthetic agent bottle.

2 **Screw sealing cap on tightly.**

WARNING!

If sealing cap is not screwed on tightly, fresh gas and anesthetic agent may escape.

- Mark bottle “Used anesthetic agent”. Recommendation: **Do not re-use**.

Flushing the Vapor

If anesthetic agent has to be removed from the wick after draining:

- Set the control dial to 5 vol.% and flush for about 5 hours at 5 L/min air or 1 hour at 15 L/min air.
- Allow gas to flow into the scavenging line.
- Press »**0**«-button and engage control dial at »**T**«. For plug-in adapters, engage locking lever in the control dial.

Storage

For storage periods longer than 6 months:

- Drain the Vapor as described on page 49 to 53 and flush out (see page 53).
- Press »**0**« button and engage control dial at »**T**«.
  For plug-in adapters, engage locking lever in the control dial.
- The Vapor may be stored in any position.
- If packing is necessary, see "Shipping", page 54.

WARNING!

Always observe permissible storage temperature range (see page 61). If the storage temperature range is exceeded, internal damage to the Vapor may occur which could cause incorrect output concentration.

Before putting the Vapor into operation again, perform inspection and service, and perform all checks specified in "Checking Readiness for Operation".

Shipping

- **Drain Vapor completely** (see page 49), clean and disinfect (see page 48).
- Disconnect Vapors from anesthesia delivery systems for shipping – unless permanently connected.
- Engage control dial at »**T**«.
- Each Vapor must be packed **separately** with care.
  Use original packaging, if possible. If original packing is not available, use strong packing with at least 5 cm of impact-resistant material around each Vapor.
  Fasten packing securely.

WARNING!

Liquid anesthetic agents and filled Vapors are subject to Hazardous Goods Regulations (under no. UN 8027 in accordance with Class 9 of IATA/ICAO). These regulations do not apply to the residues of anesthetic agents left in the wick after draining.

Return, Disposal

When repair is not economical, DrägerService offers an exchange service for disposing of Vapors.

Before disposal, drain completely (see page 49), flush out, (see page 53), clean and disinfect (see page 48).

Worn parts can be disposed of with regular refuse.

Maintenance Intervals

WARNING!

Preventive Maintenance work on Vapor 2000 anesthetic vaporizers shall be performed by trained and factory authorized staff only.

CAUTION!

In case of malfunction of this device, contact your local DrägerService or our Factory Authorized Technical Service Center.

The device must be inspected and serviced (preventive maintenance) by trained and factory authorized technical service representatives at regular 6 month intervals.
A record must be kept on this preventive maintenance.

Maintenance or repair of the Vapor 2000 anesthetic vaporizer shall be performed only by Dräger authorized technical service representatives.

Inspection and Service[1)]

Every six months, at the same time as the anesthesia delivery system, to be carried out by trained and factory authorized service personnel, following an approved protocol.

Recommendation: Call DrägerService for inspection and service.

WARNING!

To avoid any risk of infection, clean and disinfect Vapor before any maintenance according to established hospital procedures – this applies also when returning Vapors for repair (see page 48).

The Vapor 2000 maintenance schedule is specified in the DrägerService Test Certificate for the Vapor 2000. The below listed wear parts must be replaced if inproper function is identified during maintenance or routine check by the customer.

Wear parts

The following listed parts are specified as wear parts:
- Gas inlet filter
- Mounting screws
- Seal of keyed filling system (interface keyed filler adapter)
- Quik Fil and funnel filling system locking cap seal
- Drainage valve seal
- Vaporizing chamber valve
- Vaporizing chamber wick (only Halothane)

1) For definitions, see page 7.

Troubleshooting

Fault	Cause	Remedy
Operation		
No concentration delivered or concentration excessively high/low	Vapor not full, Vapor empty	Fill Vapor
	Control dial setting at »**0**« or »**T**«	Set control dial to ≥0.2 vol.%
	No Vapor connected, or if several connections, one unoccupied and open	Connect Vapor, or close open connections with Vapor or by direct gas connections
	Vapor tilted during or before operation when control dial not at »**T**« setting. If this has happened, liquid anesthetic agent may have entered flow control system	**Before operation: flush and then check concentration**, see "Transport, procedure after tilting", page 58
	Vapor filled with incorrect anesthetic agent or mixture of agents	Drain Vapor and blow off, see pages 49 to page 53; repair[1)]
	Gas is flowing through Vapor in wrong direction	Check connecting system, see page 21
	Leak, e.g. plug-in adapter is not fitted flush on seals	Disconnect Vapor; check plug-in adapter safety locking device and sealing rings; replace. Leak test with Vapor at control dial setting »0« and ≥0.2 vol.%
	Valves in plug-in connector damaged	Repair[1)]
	Vapor temperature outside specified application range, e.g. filled with very cold anesthetic agent, or operated with both flow and concentration high over a prolonged period	Allow Vapor to reach normal temperature, allowing at least 15 min per °C deviation from specified range, see page 67; refill with anesthetic agent at room temperature
	Vapor being operated with carrier gas other than air	Concentration changed because of carrier gas, see page 37 and page 69.
	Monitor displays volume percentage, not partial pressure	To convert measured value to partial pressure, see page 38
	Vapor or anesthetic monitor faulty	Check with another Vapor to establish whether Vapor or anesthetic agent monitor faulty, repair[1)]

1) to be carried out only by trained and factory authorized service personnel

Fault	Cause	Remedy
The vaporizer detection system on anesthesia delivery system to which Vapor is connected displays anesthetic agent which is different from the Vapor	Coding of plug-in adapter or Vapor damaged, faulty, or incorrectly installed	Check coding, if necessary re-install, repair[1)]
Monitor indicates different anesthetic agent from that on the Vapor (applies only to anesthetic agent monitors with anesthetic agent detection system)	A different anesthetic agent has just been used and high concentrations of it are still present in the breathing system	Flush breathing system or wait for gas to change
	Monitor has not been switched over after anesthetic agent has been changed	Switch over monitor
	Incorrect anesthetic agent or anesthetic agent mixture in Vapor	Check Vapor, drain and blow off, see pages 49 to page 53; repair[1)]
Control dial cannot be set to concentration	»**0**« button not pressed	Press »**0**« button
	Interlock not switched over; Interlock jamming or another vaporizer still switched on	Switch off other vaporizer and switch over Interlock. Checks, see page 42; repair[1)]
Control dial can be moved from »**0**« to »**T**« without pressing button	»**0**« button defective	Repair[1)]
Smell of anesthetic agent, anesthetic agent vapor leaking, leakage too high during leak test	Plug-in adapter not fitted flush	Check plug-in connector sealing rings and sealing surfaces; alternatively locking lever not engaged or was twisted before connection
	Sealing cap on filling system not tightened, or defective seals	Tighten sealing cap on filling system, or check seals, replacing if required, or repair[1)]
	Drainage screw not closed	Screw drainage screw tight
	Lever of key-indexed filling system too loose so that seals not compressed enough	Adjust lever; repair[1)]
	Sealing block on key indexed filling system not fully pushed in	Loosen lever, push sealing block in fully, re-tighten lever

1) to be carried out only by trained and factory authorized service personnel

Fault	Cause	Remedy
Filling level cannot be read in viewing glass	Vapor completely empty	Refill Vapor
	Vapor overfilled	Drain Vapor to maximum mark. Check concentration
	Viewing glass display faulty	Repair[1)]
Anesthetic agent is obscured in viewing glass.	Halothane contains thymol, which has accumulated in the vaporizer	Drain discolored substance completely; clean Vapor, see page 36

Transport, procedure after tilting

Anesthetic agent has leaked	Control dial not engaged at »**T**« and Vapor tilted at an angle of more than 30°	Place Vapor upright. Set control dial to »**T**« and engage. — flush Vapor for 2 hours at 10 L/min or 8 hours at 4 L/min. — set Vapor at maximum concentration and flush for 5 minutes at 10 L/min. — Check concentration at 0.5 L/min Air with control dial set at »**0**«. Concentration must be less than 0.1 vol.%. If not, flush as above. Check concentration, see page 37. If output concentration is not within permissible range, do not use Vapor. Repair[1)]
Vapor not set at »**T**«, even though it is not connected to anesthesia delivery system	Vapor may have been tilted at an angle of more than 30° when last handled. Liquid anesthetic agent may have leaked or entered flow control system yielding incorrect concentration	Flush before start-up and check concentration, see above
Smell of anesthetic agent during or after transport	Anesthetic agent vapor may escape or liquid anesthetic leak because of pressure in Vapor when an extreme rise in temperature and/or drop in atmospheric pressure has occurred, see page 62	**Do not inhale anesthetic agent vapor. Ventilate room.** Allow Vapor to reach normal temperature. Do not exceed application range for filled Vapor with control dial set at »**T**« see page 61. Flush before start-up and check concentration, see above

1) to be carried out only by trained and factory authorized service personnel

Fault	Cause	Remedy
Draining and filling Vapor		
Anesthetic agent is leaking from drainage outlet	Drain valve not closed	Close drain valve
Vapor accidentally filled with incorrect anesthetic agent		Drain Vapor completely and blow off, see pages 49 to page 53; repair[1)]
Anesthetic agent does not flow into Vapor	Keyed filler adapter being used without check valve	Use keyed filler adapter with check valve or modify
Anesthetic agent leaks from bottle thread	Keyed filler adapter not screwed tight enough on bottle	Screw keyed filler adapter on firmly
	Seal in screw-cap on keyed filler adapter missing or damaged	Check seals, Repair[1)]
Anesthetic agent leaks from filling system	Keyed filler adapter not inserted properly or lever not tightened properly	Loosen lever, push keyed filler adapter in as far as it will go; tighten lever
	Lever does not press down sufficiently firmly onto keyed filler adapter	Adjust lever, Repair[1)]
	Keyed filler adapter damaged	Use another keyed filler adapter
	Seal on filling system damaged	Leak test Vapor with control dial set at ≥0.2 vol.%. Repair[1)]
Anesthetic agent is leaking from overflow	Vapor filled above maximum	Drain Vapor to maximum mark; check concentration
Sealing block cannot be removed	Lever not opened enough, or lever incorrectly set	Open lever further, or have it adjusted[1)]
Anesthetic agent does not flow out when draining	When control dial is set at »**T**« vaporizer chamber is hermetically sealed	When draining with control dial set at »**T**« open locking device on filling outlet; close filling outlet again tightly after draining
Quik Fil drain adapter overflows	Drain valve opened too far	Do not open drain valve so far
	Bottle screwed on incorrectly or not fully so that bottle valve does not open	Unscrew bottle from drain adapter, screw on again
	Bottle full	Unscrew drain adapter and screw onto another suitable bottle; continue draining

1) to be carried out only by trained and factory authorized service personnel

Fault	Cause	Remedy
Plug-in adapter		
Locking lever does not engage in control dial when disconnected	Control dial still set at »**0**«	Set control dial to »**T**« and engage
Locking lever cannot be swung out of the control dial	Control dial to »**0**« or ≥0.2 vol.%. During preceding transport, control dial may have been set at »**0**« or ≥0.2 vol.%, liquid anesthetic agent may have entered the flow control system to give an incorrect concentration	Set control dial to »**T**« and engage. **Flush before start-up and check concentration:** see "Transport, procedure after tilting", page 58
Vapor cannot be disconnected	Control dial not set at »T«	Set control dial to »**T**« and engage
	Interlock still engaged	Disengage Interlock
	Locking lever cannot be swung back into control dial; locking device between plug-in adapter and plug-in connector is jammed	Remove locking cap on top of locking lever shaft; loosen screw in shaft with 3 mm hexagon socket spanner so that Vapor can be disconnected; repair[1)]
Plug-in adapter not installation flush on plug-in connector seals	Locking lever not engaged in control dial, as control dial is set at »**0**« or ≥0.2 vol.%	Set control dial to »**T**« and engage; insert pin on locking lever into socket on control dial and engage
	Engagement mechanism on plug-in adapter or plug-in connector damaged	Excessive force used may lead to jamming or problems when disconnecting. Repair[1)]
	Locking lever was turned to the left before connection	Disconnect Vapor (control dial at »**T**«); engage locking lever in control dial; re-connect Vapor
	O-rings on plug-in adapter missing	Install o-rings
	Extra o-ring on a pin on the plug-in connector or foreign body between plug-in connector and plug-in adapter	Remove o-ring or foreign body
For plug-in adapter S-2000 only: Control dial cannot be turned	Interlock pins are not in their original position	Check whether control dial can be turned after adjacent vaporizers have been disconnected; squeeze both interlock pins inwards by hand, one after the other, and release. If this does not correct the problem; repair[1)]

1) to be carried out only by trained and factory authorized service personnel

Technical Data

Classification as per EC Directive 93/42/EEC Annex IX	Class II b
UMDNS-Code Universal Medical Device Nomenclature System – Nomenclature for medical products	10-144
Operating range	
Ambient and Vapor Temperature	
during operation	10 to 40 °C ; but Halothane and Isoflurane Vapors may only be operated between 35 and 40 °C if atmospheric pressure is between 850 and 1100 cm H_2O
during shut-down (filled, control dial at »**T**«)	0 to 40 °C
during storage (empty, dry wick)	–20 to 70 °C
Atmospheric pressure	
during operation and shut-down (filled, control dial at »**T**«)	700 to 1100 cm H_2O but Halothane and Isoflurane Vapors may only be operated between 35 and 40 °C if atmospheric pressure is between 850 and 1100 cm H_2O
during storage (empty, dry wick)	500 to 1200 cm H_2O
Relative humidity	0 to 95 %
Flow range	0.25 to 15 L/min 0.25 to 10 L/min for concentrations >5 vol.%
Direction of flow	as per arrow on back of Vapor (see page 21)
Quality of gases required	Clean, medically pure mixtures of O_2 and air or O_2 and N_2O O_2 and air: dewpoint ≤5 °C at 72.5 psi (5 bar) N_2O: water content ≤2 mg/L at 72.5 psi (5 bar)
Difference between pressure range and ambient pressure on Vapor outlet (e.g. due to machine components or O_2 flush)	–100 to 200 cm H_2O
Alternating pressure due to ventilation on Vapor outlet, relative to pressure on Vapor outlet without ventilation	–10 to 80 cm H_2O
Maximum angle of tilt	
alone, freestanding	10°
during operation	30°
during transport (control dial at »**T**«)	any position and angle

Set values

0 and 0.2 to maximum concentration on control dial scale.
When control dial at »**0**« and »**T**« no output of anesthetic agent.

Accuracy of concentration delivered (highest value always applies)

	at 15 to 35 °C at 0.25 to 10 L/min	at 10 to 15 °C at 35 to 40 °C at 10 to 15 L/min
Vapors up to 6 vol.% max. concentration	±0.20 vol.% or ±20 % rel.,	+0.30 / −0.20 vol.% or +25 / −20 % rel.
Vapors above 6 vol.% concentration	±0.25 vol.% or ±20 % rel.,	+0.35 / −0.25 vol.% or +30 / −20 % rel.

including one of the following conditions (single parameter variation):

- variation of air flow in range given at 22 °C room and Vapor temperature and 1013 cm H_2O or
- variation of temperature in range given at an air flow of 2.5 L/min and 1013 cm H_2O or
- variation of atmospheric pressure in range given at Air flows of 2.5 L/min air and 22 °C room and Vapor temperature
- variation of operating time at 22 °C, air flow of 2.5 L/min and 1013 cm H_2O, provided that Vapor temperature does not deviate from the range given above.

Filling volume for anesthetic agent

about 360 mL with dry wick
about 300 mL with moist wick
about 260 mL between minimum and maximum mark

Consumption of anesthetic agent [mL/hour]

~3 x fresh gas flow [L/min] x concentration [vol.%]

Rough formula for running time [hours] = (for 260 mL anesthetic agent)

$$\frac{85}{\text{Fresh gas flow [L/min]} \bullet \text{concentration [vol.\%]}}$$

Example: Fresh gas flow = 2 L/min, concentration = 1.4 vol.%
running time = 30 hours

Loss of anesthetic agent into atmosphere per 24 hours in mL liquid

	10 °C	22 °C	40 °C
setting »**0**« (max. 30° tilted)	0.3	0.5	0.7
setting »**T**« (max. 30° tilted)	0.2	0.3	0.4
setting »**T**« (horizontal or upside down)	0.8	1.5	2.5

Anesthetic agent only escapes in very small quantities (<2.5 mL) into Vapor or towards patient.

Flow resistance (without connector) at 10 L/min air in cm H_2O

	10 °C	22 °C	40 °C
Vapor set at »**0**« or »**T**«	<40	<35	<30
Vapor switched on	<150	<70	<35

Materials

Vapor 2000 contains **no** latex.

Vapor conforms to Standards[1)]	EN 740[2) 3) 4)] DIN 13252[2) 4)] ASTM F1161 CSA-Z168.3 ISO 5358 ISO 8835 (1997) [2) 3) 4)] 93/42/EEC Medical Device Directive
The keyed filling system and Quik Fil filling system conform to the following Standards for anesthetic agent-specific filling systems:	EN 1280 ISO 5360 CSA-Z5360
23 mm tapered connector	ISO 5356-1

1) When used in combination with other machines/medical products the relevant standards for the machine combination must be followed.
2) These standards require an anesthetic agent-specific filling system.
3) Conforms to IEC 601-1/EN 60601-1.
4) These standards require anesthetic agent measurement for operation of Vapor with an anesthesia delivery system.

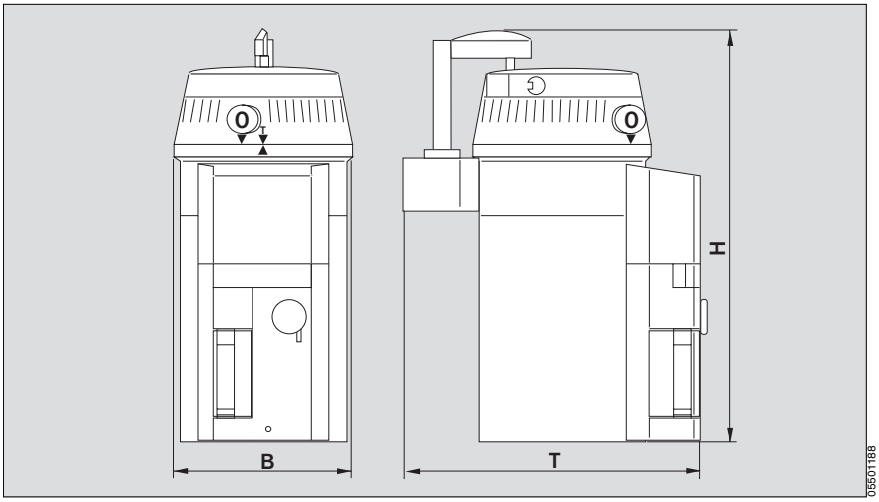
Vapor dimensions and weight

with keyed filling system

	Dimensions in mm		
Connector	B	H	T
DW-2000	108	246	188
S-2000	120	246	188
Cone	133	226	158 to 200[5)]
Permanent	108	226	145

5) Depending on Vapor installation to anesthesia delivery system

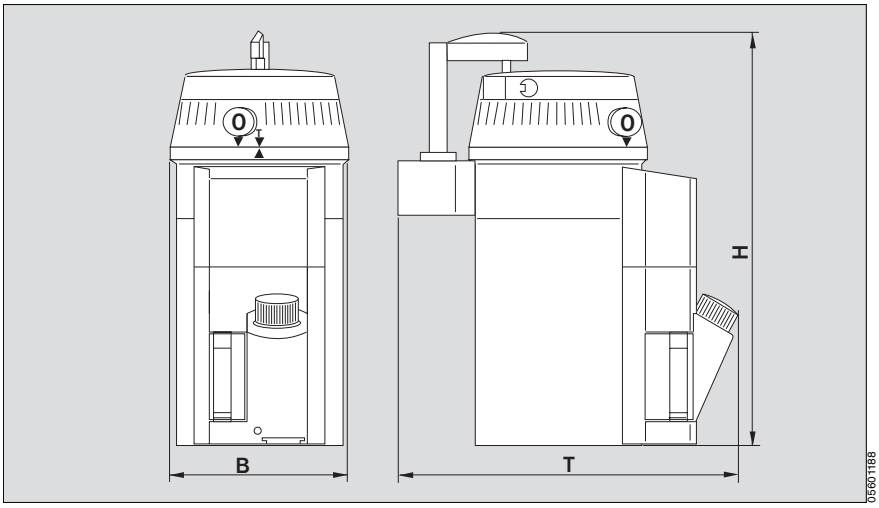
	Weight in kg	
Connector	empty	full
DW-2000	7.8	8.5
S-2000	7.6	8.3
Cone	7.8 to 8.1	8.5 to 8.8
Permanent	7.2	7.9



with Quik Fil or with funnel system

	Dimensions in mm		
Connector	B	H	T
DW-2000	108	246	197
S-2000	120	246	210
Cone	133	226	180 to 222[5)]
Permanent	108	226	163

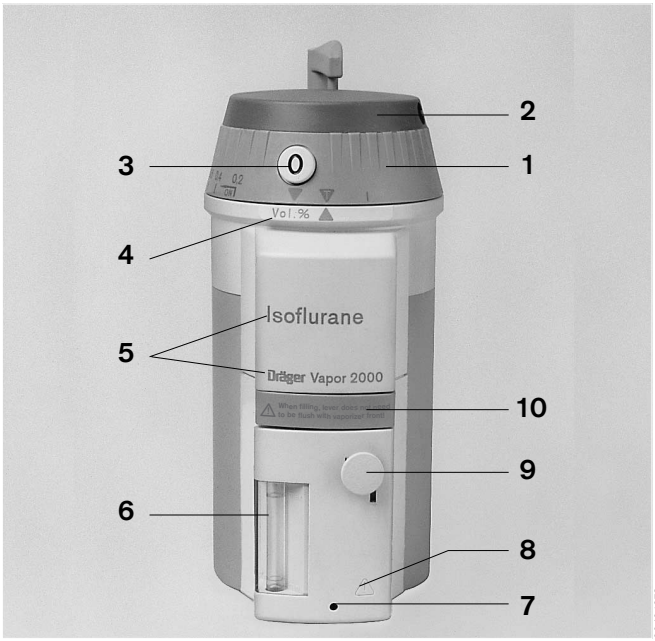
	Weight in kg	
Connector	empty	full
DW-2000	8.1	8.8
S-2000	7.9	8.6
Cone	8.1 to 8.4	8.8 to 9.1
Permanent	7.5	8.2



What's What

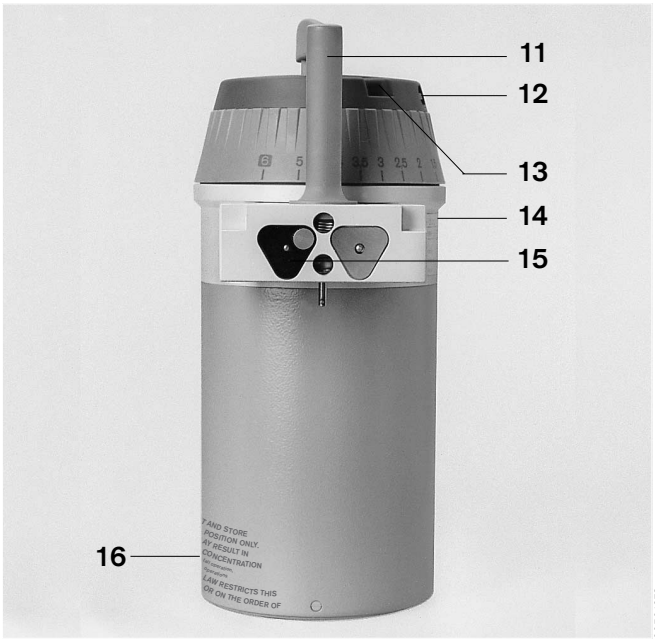
Front view

1 Control dial with concentration scale and letter for anesthetic agent
2 Control dial cap color coded for anesthetic agent with Interlock coding
3 »**0**« button for setting »**0**« and »**T**«
4 Indication of concentration units
5 Indication of anesthetic agent and Vapor type
6 Viewing glass for filling level
7 Drainage valve
8 "Observe Operating Instructions" symbol
9 Filling system (illustrated: keyed filling system)
10 Lever with label



Back view

11 Locking lever for plug-in system
12 Opening for Interlock locking (illustrated: Interlock 2)
13 Slot for locking lever to prevent the Vapor being disconnected from the anesthesia delivery system except when the control dial is at »**T**«
14 Type plate with manufacturer and type details, serial no.
15 Connecting system (illustrated: plug-in adapter DW-2000 with anesthetic agent-specific color-coding) and code letter
16 Label



Theory of Operation

Operating Principles

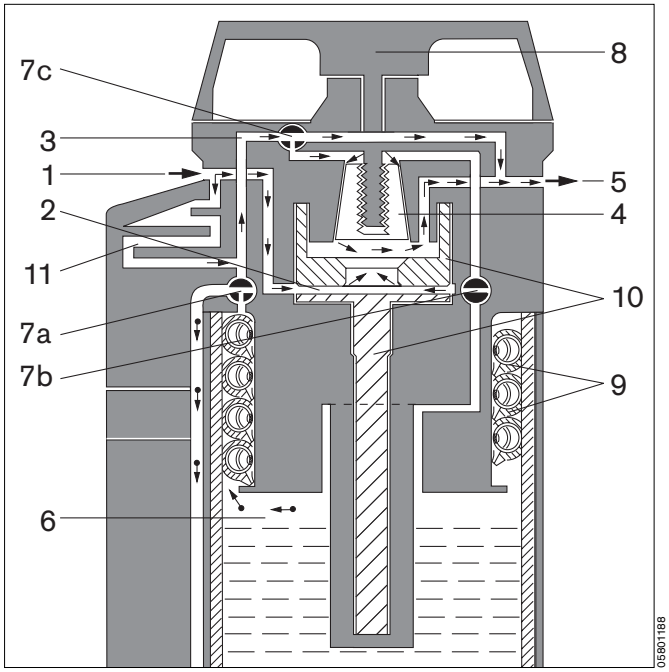
Control dial at »0« (switched off)

Fresh gas (arrow) flows from Vapor inlet **1** to the vaporizing chamber-bypass **2** and then passes from the outside to the inside through this gap. In parallel, some of the fresh gas flows via an additional bypass **3** and flow control cone **4** to Vapor outlet **5**.

The vaporizing chamber **6** is completely shut off from the gas flow by valves **7a** and **7b**. No anesthetic agent can enter the dosing gap and the fresh gas.

A small bleed hole in valve **7a** connects the vaporizing chamber to the atmosphere to prevent any build-up of pressure. Through diffusion and pressure equalization during temperature and pressure fluctuations small quantities of anesthetic agent Vapor may escape. This process is hindered by ducts and buffer volumes.

When the Vapor is at an angle, anesthetic agent may leak through the bleed hole in the vaporizing chamber.



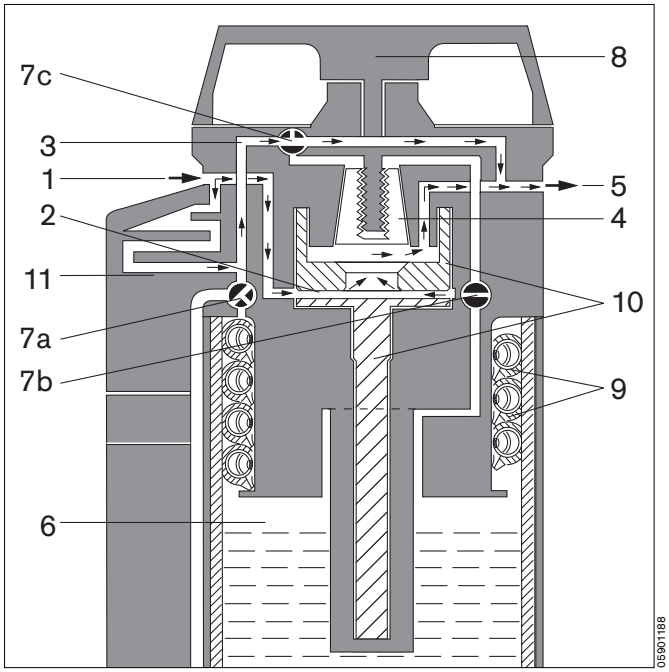
Control dial at »T« (transport)

Fresh gas no longer flows over valve **7c** to the flow control cone **4**. The bleed hole in the vaporizing chamber is closed by valve **7a**. No anesthetic agent vapor can escape and the Vapor is protected against overflowing, even when at an angle. It may be transported in any position.

Closing off the vaporizing chamber completely may result in a small positive or negative pressure due to temperature and pressure fluctuations in the room.

Higher pressure is only caused by a rapid rise in temperature and/or falling atmospheric pressure, e.g. during transport in the sun or at high altitudes.

This pressure is adjusted to ambient conditions by setting the control dial to »**0**« or by opening the filling system. Small quantities of anesthetic agent may escape during these processes.



Control dial above »ON« (switched on)

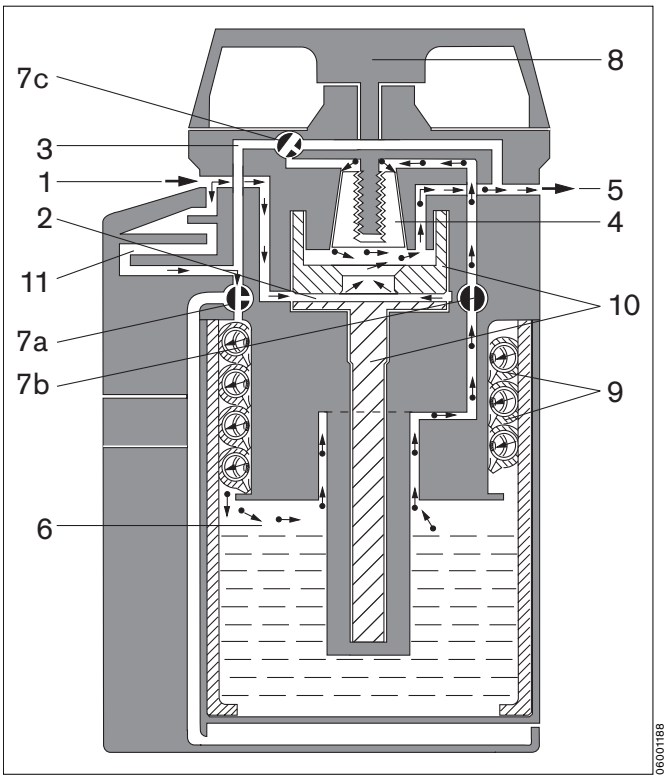
Fresh gas (arrow) is routed through valves **7a** and **7b**, linked to the control dial **8** and through the vaporizing chamber **6**. Valve **7c** closes off bypass **3**.

Some of the fresh gas is enriched with anesthetic agent vapor (arrow with dot) in the saturated wick **9**. The rest of the fresh gas is routed past the vaporizing chamber **6** through a bypass **2**.

The two flows are mixed in the space behind the two flow controls and routed to outlet **5**. The concentration is the result of mixing the two gas flows and of the saturation concentration of the anesthetic agent.

The concentration of anesthetic agent is also influenced by the temperature compensator **10**, which makes use of the thermal expansion characteristics of two different materials to expand or contract the vaporizing chamber bypass **2**, depending on temperature. This process compensates for the influence of temperature on saturation.

The pressure compensating labyrinth **11** effectively reduces any pumping effect caused by pressure fluctuations (see "Influence of Fluctuations in Pressure During Ventilation", page 71).



Calibration

Each Vapor is calibrated individually at 22 °C with a 2.5 L/min continuous air flow without ventilation pressure, and tested at 22 °C and 30 °C and at air flows of 2.5 L/min and 10 L/min.

Calibration is in % partial pressure (% of 1013 cm H_2O) as the depth of anesthesia depends on the patient's uptake which is itself determined by partial pressure.

Concentration delivered in % partial pressure at normal pressure of 1013 cm H_2O is identical numerically with the output given in volume percent, so the marking on the Vapor is given in vol.%.

The output in vol.% must be corrected for other atmospheric pressure values (see "Influence of Atmospheric Pressure", page 70) but partial pressure always remains constant (see also pages 37 and 69).

For simplicity, settings on the Vapor and in the Operating Instructions are given in the abbreviated form of vol.%, which means vol.% at 1013 cm H_2O and % partial pressure in the abbreviated form.

The scale values on the control dial show the concentration delivered at 22 °C with dry gases (see "Technical Data", page 61).

Influence of Temperature

Vapor compensates for changes in temperature. The saturation concentration of the anesthetic agent, which rises with temperature, is automatically balanced by routing a higher proportion of the gas flow through the vaporizing chamber-bypass (see page 65).

The linear change of the bypass gap changes flow through the bypass in a nonlinear fashion. This non-linearity does match the non-linear variation of partial pressure for the full temperature range not exactly, so that the delivered concentration still remains slightly dependent on temperature.

The diagrams show typical temperature dependence when operating with a 2.5 L/min flow of air. The deviations increase for temperatures outside this range, despite continuing compensation.

Under no circumstances must the temperature of the anesthetic agent reach boiling point, as the output concentration will then become impossible to control.

The boiling point drops with increasing altitude:

Atmospheric Pressure/ Altitude	Boiling point of anesthetic agent °C			
	1013 cm H_2O 0 m	900 cm H_2O 1000 m	800 cm H_2O 2000 m	700 cm H_2O 3000 m
Halothane	50.2	46.8	43.4	39.8
Enflurane	56.5	53.4	50.3	46.8
Isoflurane	48.5	45.4	42.2	38.9
Servoflurane	58.6	53.4	52.1	48.7

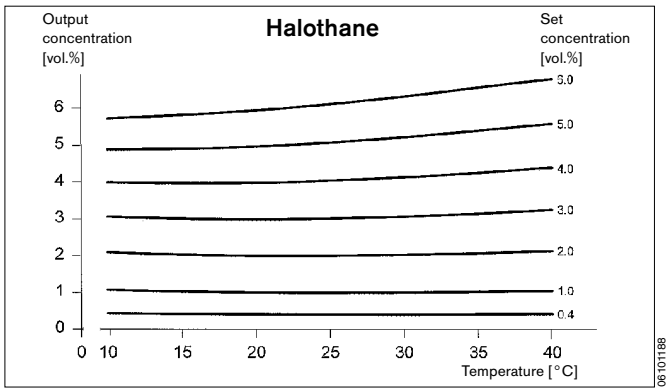
= non-permissible operating ranges.

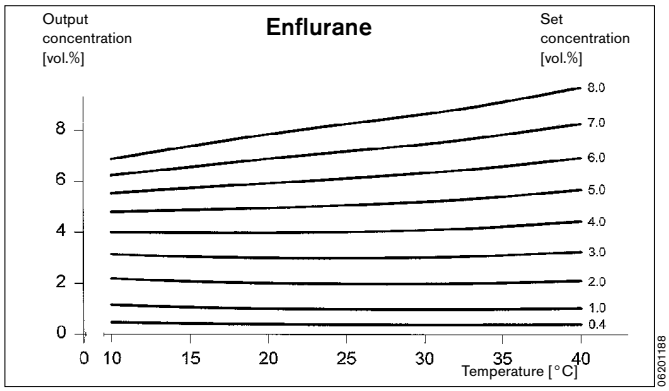
The operating range for the Vapor when used with Dräger anesthesia delivery systems has been set in such a way that, in the critical situation of 700 cm H_2O, 40 °C (or 850 cm H_2O for Halothane or Isoflurane Vapors) and a maximum negative pressure of –100 cm H_2O on the Vapor, the boiling point of the anesthetic agent cannot be reached.

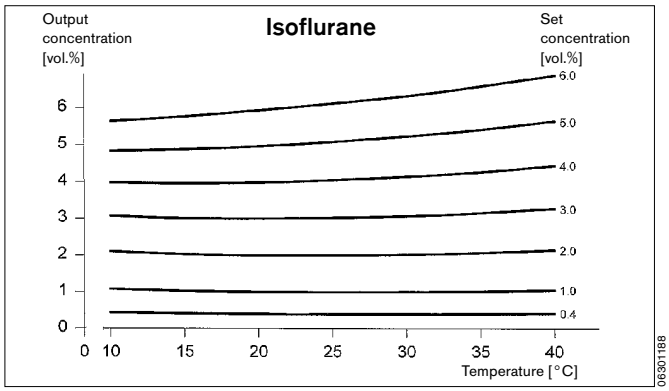
The extension of temperature compensation is independent of aging and hysteresis and the Vapor's large mass also provides some compensation for differences in temperature.

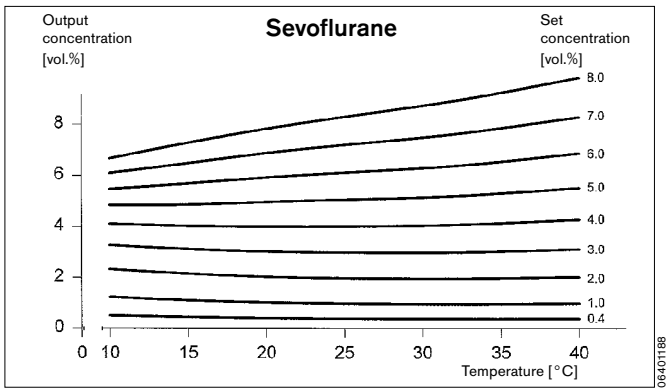
Differences in temperature between the Vapor and the atmosphere within the operating range are compensated for within the concentration accuracy specified. If the temperature of the Vapor before use is outside the range of 10 to 40 °C, 15 min/°C has to be allowed for temperature adjustment, if the concentration is to remain within the accuracy specified.

When Vapor is being operated with a high gas flow or a high concentration, it cools through evaporation (see "Influence of Running Time", page 72).







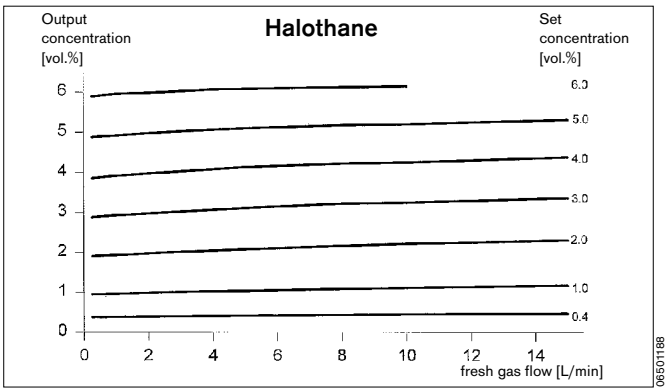


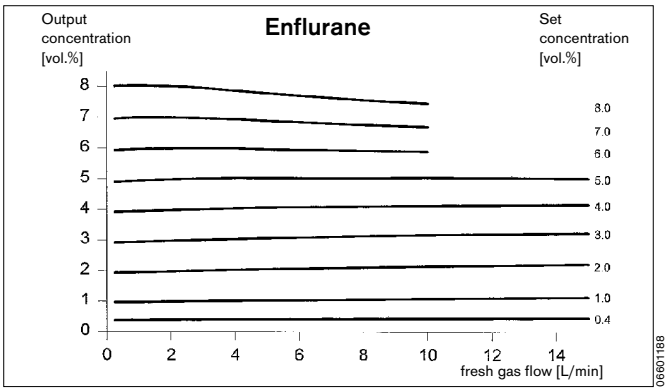
Influence of Flow

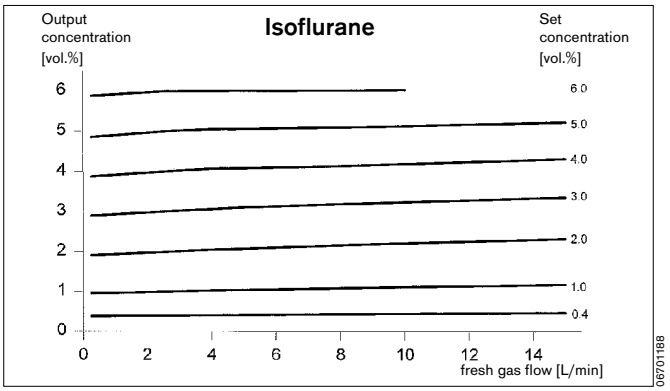
Within the specified flow range, the concentration delivered by the Vapor is only slightly dependent on fresh gas flow.
The output concentration is reduced slightly when high concentrations are set at the same time as a high fresh gas flow. Under such conditions, total saturation of the gas flowing through the vaporizing chamber does not occur and also full compensation is not made for the cooling of the anesthetic agent due to evaporation
(see "Influence of Running Time", page 72).

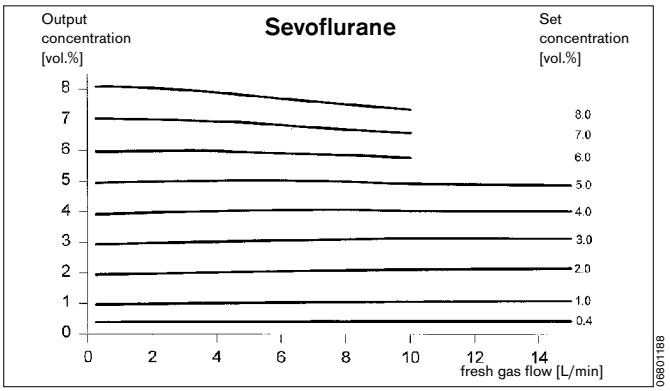
The diagrams show the typical influence of flow on the concentration delivered after 1 minute at 22 °C, 1013 cm H_2O when operating with air

.









Influence of Gas Composition

The delivered concentration is dependent on the composition of the fresh gas since the viscosity and density of the gas changes from one gas to another. The Vapor is calibrated with air because the concentration delivered is then exactly in the middle of the range for the available anesthetic gas mixtures.

When 100 % O_2 is used, the output concentration compared with air rises by 10 % of the set value, and by not more than 0.4 vol.%.

When a mixture of 30 % O_2 and 70 % N_2O is used, the concentration drops by 10 % of the set value at the most, and by not more than 0.4 vol.%.

The effect of gas composition is different for different anesthetic agents and, for this reason, maximum effects are given here.

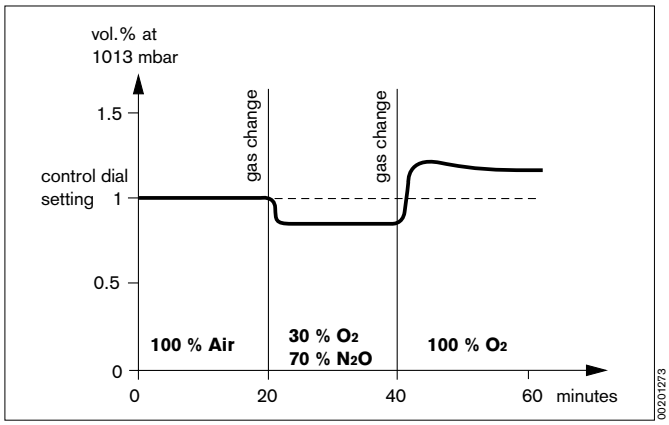
When changing from one gas mixture to another, an additional dynamic effect can occur. This may result in a further deviation in concentration until all of the previous fresh gas is flushed out of the vaporizing chamber.

These deviations and their duration will all be greater,

- the lower the volume of anesthetic agent in the Vapor,
- the higher the concentration set,
- the lower the gas flow and,
- the more extreme the change of gas type.

The extent of this dynamic deviation increases as gas flow increases, though the duration of the deviation will decrease.

Influence of gas composition on output concentration in carrier gas at 1 vol.% setting.



If the humidity in a gas is higher than that specified in "Technical Data" output concentration will be affected slightly.

Influence of Atmospheric Pressure

The anesthetic agent partial pressure delivered by Vapor (see "Calibration", see page 66) is all but independent of atmospheric pressure. Therefore weather-induced fluctuations do not need to be taken into account and altitude-induced pressure changes in the range 700 to 1100 cm H_2O will only lead to small deviations within the accuracy specified. For this reason, the physiological effect – the depth of anesthesia at a defined Vapor setting – is independent of atmospheric pressure.

When measuring the output concentration of Vapor in partial pressure (e.g. with Dräger IRIS or PM 8030/35) there is no influence from ambient pressure.

When measuring in volume percent (e.g. Dräger PM 8020 or PM 8050), the measured values do, however, change with atmospheric pressure, and measured values rise when atmospheric pressure drops below 1013 cm H_2O.

The following formula for conversion applies:

$$\text{Concentration [\% partial pressure]} = \frac{\text{Measured value [vol.\%]} \cdot \text{atmospheric pressure [cm } H_2O\text{]}}{1013 \text{ cm } H_2O}$$

Example:
At 4 % partial pressure at an altitude of 1000 m and at 900 cm H_2O, 4.5 vol.% is displayed, and 5.1 vol.% at an altitude of 2000 m at 795 cm H_2O.

WARNING!

Under no circumstances should Vapor ever be used at atmospheric pressures and temperatures at which the anesthetic agent could start to boil (see page 67), as the concentration delivered will rise and be uncontrolled.

Influence of Positive/Negative Pressure Relative to Ambient and Dynamic Pressure

The Vapor's operating range is limited to between –100 and 200 cm H_2O, relative to ambient atmospheric pressure at the Vapor outlet.

Pressure in the Vapor is slightly higher than ambient atmospheric pressure, as the fresh gas flow builds up a dynamic pressure of up to 115 cm H_2O in the flow control system.

Vapor cannot distinguish between a constant dynamic pressure and an ambient pressure influenced by altitude. For this reason, the influence on output concentration is in accordance with the data given above under "Influence of atmospheric pressure".

For effective O_2 flushing on Dräger anesthesia delivery systems a negative pressure is produced at the Vapor outlet which may be up to 100 cm H_2O.
100 cm H_2O negative pressure has the same effect as raising the altitude by 1000 m or a drop in boiling point of about 3.5 °C (see page 67). As a protection against excessive pressure, e.g. if the fresh gas hose is kinked, the Vapor has a self-resetting pressure relief mechanism which vents the fresh gas to the atmosphere at high pressures.

Influence of Fluctuations in Pressure During Ventilation

When ventilation is performed or when the O_2 flush is operated without fresh gas de-coupling, pressure fluctuations on the anesthetic vaporizer can cause a higher concentration to be delivered than is shown on the control dial setting.

The vapor in the vaporizing chamber is compressed when pressure rises, and it expands when pressure falls. If this effect is strong enough small quantities of saturated vapor will be pumped backwards through the inlet of the vaporizing chamber into the fresh gas.

This is described in the literature as the pumping effect.
This pumping effect is greater,

- the higher the ventilation pressure and ventilation frequency,
- the more rapid the fall in pressure during expiration,
- the lower the fresh gas flow,
- the lower the concentration set,
- the smaller the quantity of anesthetic agent in the vaporizer.

The compensation system of the Vapor will reduce these effects.

When using anesthesia delivery systems without fresh gas de-coupling and with ventilation pressures greater than 30 cm H_2O, Vapor should be filled completely, if concentration set is <1 vol.% and/or fresh gas flow is <1 L/min, to keep deviations due to fluctuations in pressure as low as possible.

Continuous monitoring of the inspiratory side of the breathing system will easily show when an overdosage is likely to occur. The concentration set on the Vapor can then be slightly reduced.

Influence of Running Time

Evaporation of the anesthetic agent during operation cools the Vapor slowly.
The saturation concentration of the anesthetic agent in the Vapor decreases more rapidly the longer the duration of operation, the higher the concentration set and the higher the fresh gas flow selected, i.e. when more anesthetic agent evaporates with time.
Temperature compensation counters this effectively and limits deviations in the concentration delivered. After a certain period of operation the Vapor stabilizes at a slightly lower temperature and an output concentration which is at a slight deviation from the initial value.
The accuracy given in “Technical Data”, see page 61, applies as long as the temperature of the Vapor does not drop below the lower limit of the operating range.
The diagrams show typical concentration curves over 4 hours and 6 hours of running time respectively, measured at 22 °C and 1013 cm H_2O.

The numbers on the curves refer to the operating conditions used:

1 6 or 8 vol.% at 1 L/min

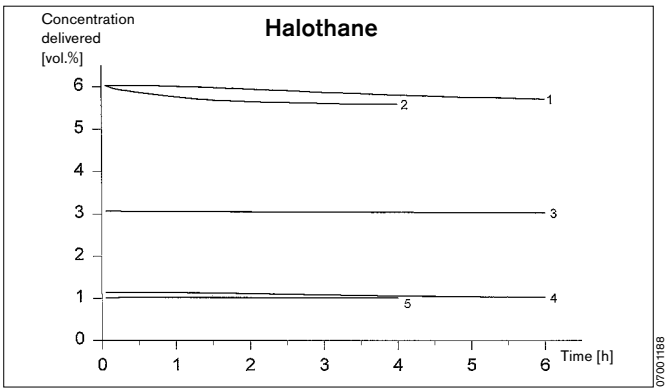
2 6 or 8 vol.% at 4 L/min

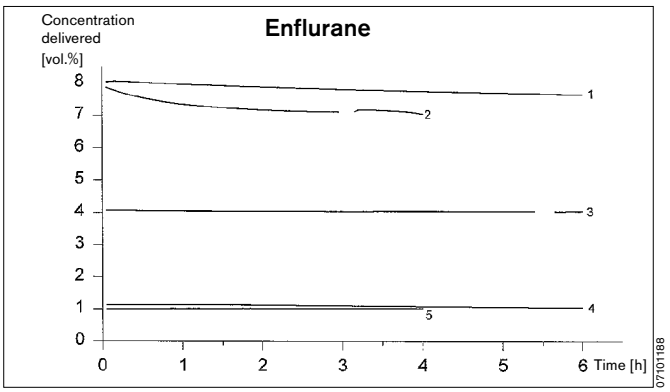
3 3 or 4 vol.% at 4 L/min

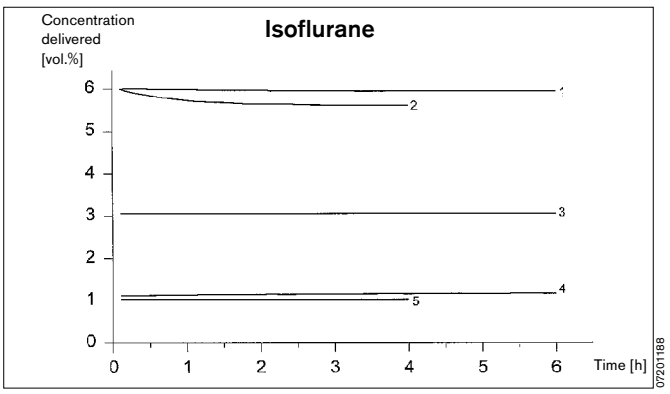
4 1 vol.% at 10 L/min

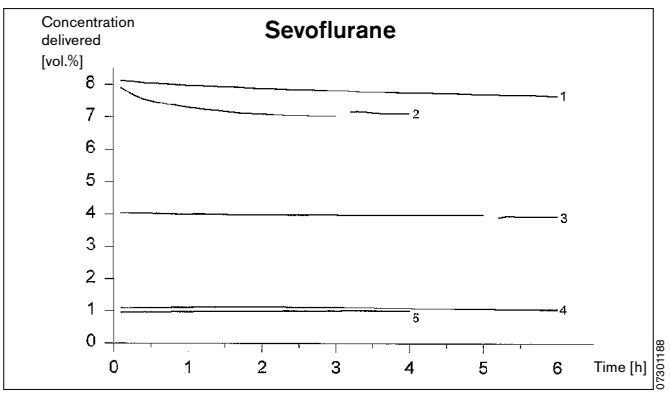
5 1 vol.% at 4 L/min

Breaks in the curves show pauses during which the anesthetic agent was being refilled.









Ordering Information

Name and description		Order no.
Keyed filler adapter s for Sevoflurane		M 31 930
Keyed filler adapter i for Isoflurane		M 30 290
Keyed filler adapter e Enflurane		M 30 289
Keyed filler adapter h Halothane		M 30 288
Ball-check valve modification set (for older Draeger keyed filler adapter)		M 34 614
Quik Fil® drain adapter		M 34 206
Parking holder for wall rail for for 2 Vapors with plug-in adapters		M 26 966
Parking holder for wall mounting for 2 Vapors with plug-in adapters		M 26 374
Operating Instructions	German	DB 01188
	English (UK)	DB 01189
	French	DB 01190
	Spanish	DB 01191
	Italian	DB 01260
	Dutch	DB 01261
	Swedish	DB 01262
	English (US)	DB 01273
	Russian	DB 01351
Technical documentation available on request		

Index

These Instructions for Use apply only to
Vapor 2000
with Serial No.:

If no Serial No. has been filled in by Dräger these Instructions for Use are provided for general information only and are not intended for use with any specific machine or device.

Manufactured by

Dräger Medical AG & Co. KGaA
Germany
Moislinger Allee 53 – 55
D-23542 Lübeck
+49 451 8 82- 0
26 80 70
FAX +49 451 8 82- 20 80
http://www.draeger.com

Distributed by

Draeger Medical, Inc.
3136 Quarry Road
Telford, PA 18969
U.S.A.
(215) 721-5400
(800) 4DRAGER (800 437-2437)
FAX (215) 723-5935

DB 01273 - GA 5327.400 enUS

9th edition - October 2001
Subject to alteration